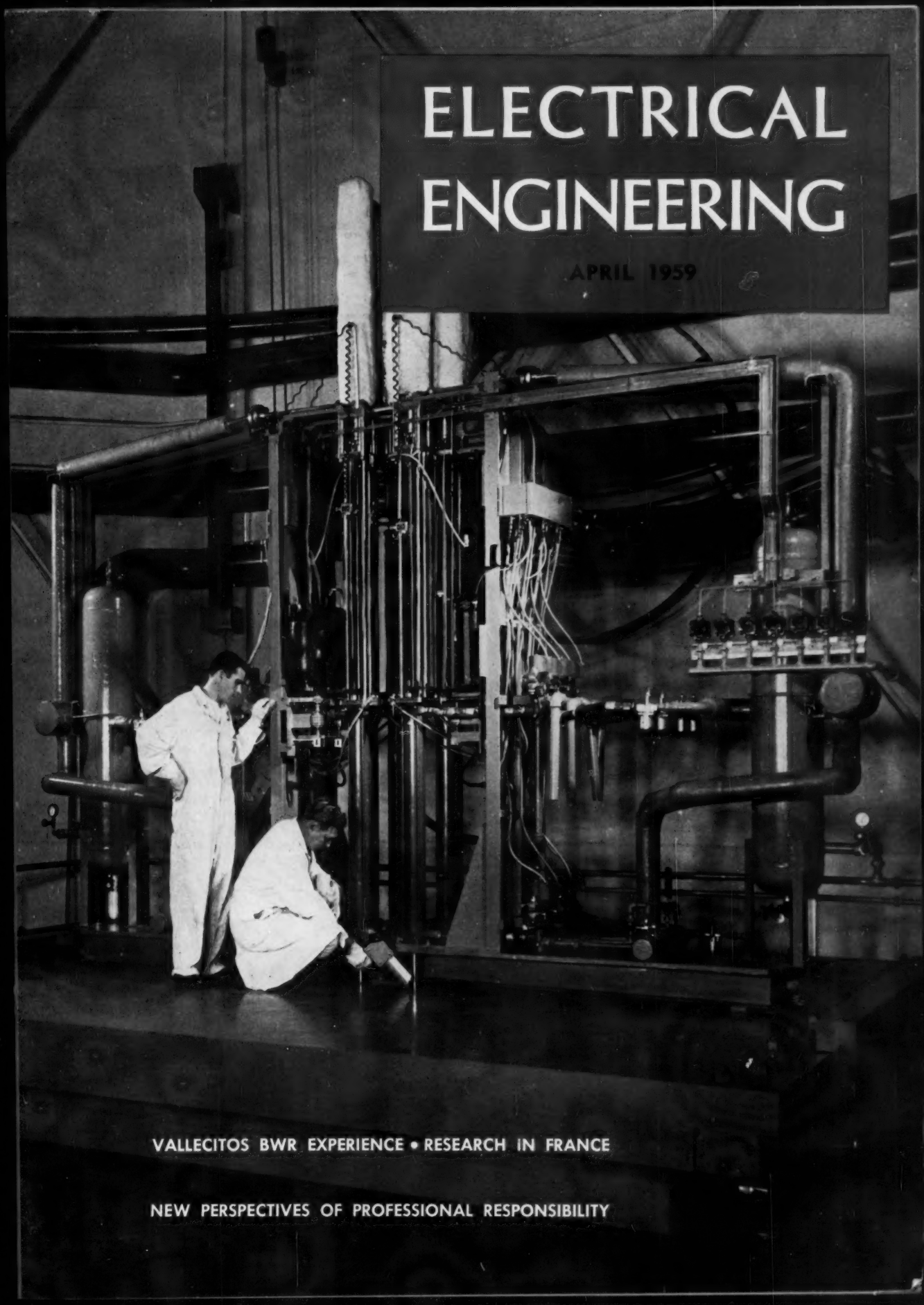


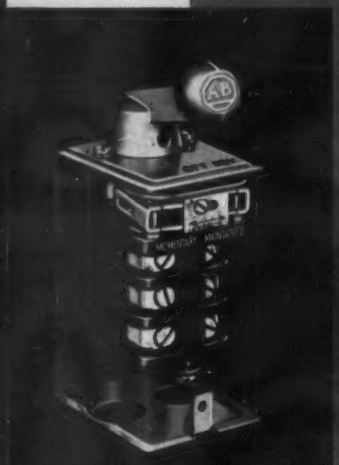
ELECTRICAL ENGINEERING

APRIL 1959

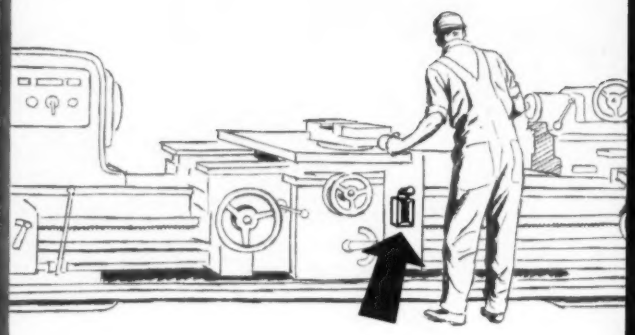
VALLECITOS BWR EXPERIENCE • RESEARCH IN FRANCE

NEW PERSPECTIVES OF PROFESSIONAL RESPONSIBILITY

ALLEN-BRADLEY REVERSING DRUM SWITCHES



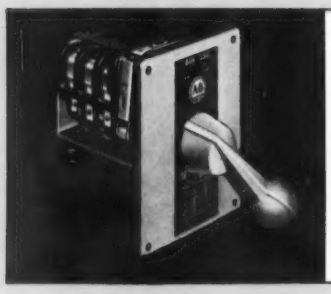
BULLETIN 350
Style A wrap-around cover is removed to show the readily accessible front wiring terminals. Max rating: 2 hp.



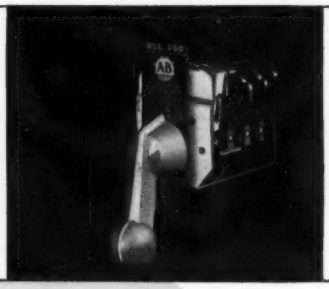
...styled to match the most modern production machines!

Inside and out—this Allen-Bradley drum switch is *all* new. Its trim, modern lines and attractive die-cast aluminum handle will give your production machines "up-to-the-minute" styling.

But there is more than beauty to this new switch. The rugged switch mechanism is a self-contained unit—independent of the enclosure. Misalignment and binding *cannot* occur. The base mounts directly on machine surfaces—without using spacers. And with the wrap-around cover removed, terminal screws are exposed for fast wiring—from the front. Changeover from momentary to maintained contact operation can be made in seconds. Investigate this new "leader" in its field. Send for Publication 6091.



OILTIGHT CAVITY MOUNTING
A-B Style AF reversing switches can be furnished with sealed shaft and rubber-gasketed, oiltight cover for cavity mounting in a machine base.



PANEL MOUNTING
The new Style A switches can be furnished for mounting directly on panels. Nameplate which gives ratings is also included with each switch.

ALLEN-BRADLEY

Quality Motor Control

Allen-Bradley Co., 1301 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ELECTRICAL ENGINEERING

APRIL 1959
Vol. 78, No. 4

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75 Years —
A Prologue to the Future

THE COVER: Interior of containment vessel of GE Vallecitos Boiling Water Reactor which is housed immediately below the 80-ton steel upper shield on which workmen are standing. Output of reactor is controlled by the control drive mechanism extending through upper shield. Article appears on page 344.

Soggy land and heavy reels of Okonite Cable presented a rugged installation problem. But by digging a 4-foot trench, and by "putting the Cat before the truck before the float," Guarantee Electrical Co. laid down two cables simultaneously at three miles per hour. Cables were a 15kv, 3-conductor Okolite-Okoprene submarine power cable and a 24-conductor Okolite-Okoprene submarine control cable designed to assure the continuous water supply essential to plant operation.

"We specified Okonite because...

This tough installation called for top-quality cables to assure continuous plant operation"

"Demanding assignments are 'our meat'," says Arthur Kaspar, Chief Electrical Engineer of Guarantee Electrical Company of St. Louis. "A good example is our recent cable installation for a large plant here in Missouri.

"Our client specified a never-failing, 24-hour-a-day, controlled source of plant water. The best pumping station site was miles from the plant, in low-water marsh land subject to periodic flooding from the Mississippi River—up to 25 feet above river level. One thing was certain . . . this called for really dependable cables for power and for control of the complex pumping station that would supply the water to the plant.

"Another thing was certain, too . . . this was a job for Okonite. Our experience has taught us that Okonite gives maximum insurance and value where dependability in vital circuits is concerned."

Conferences between Mr. Kaspar and Okonite developed the proper cables: unaffected by water, highly resistant to soil conditions and other factors that attack *any* buried or submerged cable, and backed up by Okonite's 78 years of making highest-quality cable.

* * *

For your vital circuits, take a tip from Mr. Kaspar and other leading electrical engineers and specify Okonite. Whatever the installation, when you talk to Okonite you'll get an unprejudiced recommendation for your cable needs because Okonite, *and only Okonite,* makes cable by all four insulating methods: strip, dip, extrusion and taping. The Okonite Company, Passaic, New Jersey.

5248

***where there's electrical power... there's* OKONITE CABLE**

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These S&C Cutouts reduce by shortening the arc,

As any lineman who has closed a cutout on a heavy fault knows, there's a violent blast of flame and "shrapnel." There are three ways to cut down this hazard:

1. Reduce the amount of fuse tube liner (fibre) exposed to the arc.
2. Reduce the energy of the arc.
3. Increase the bore diameter* to reduce the "muzzle velocity."

In S&C's Cutouts having interrupting ratings above 5000 amperes, all three methods are employed — together — making possible the exceptionally high interrupting ratings and at the same time reducing the violence of the blast.

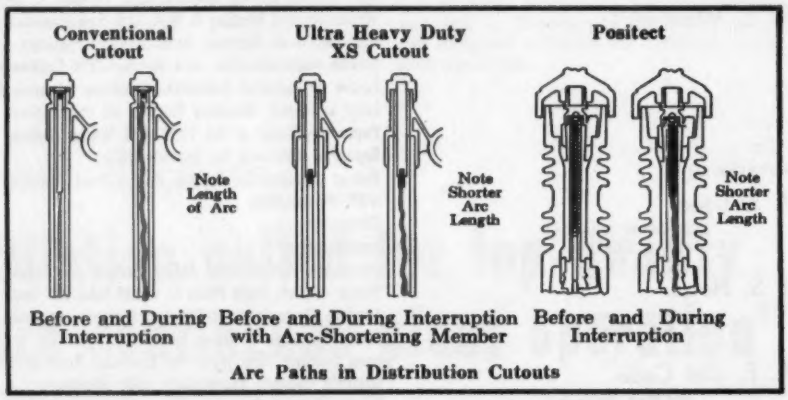
*This can be done without sacrifice of low fault interrupting capability by use of a fuse link made to interrupt low faults, in combination with a high speed terminal-separating device. In the Positect, this latter is a spring and cable assembly; in the XS, a spring-actuated cable flipper.

Here's how it's done:

The length of the arc is deliberately reduced by the use of an arc-shortening member. In the XS Cutout, this member is a husky copper rod; in the Positect, the member is a spring-and-cable assembly.

When the arc length is reduced, the arc voltage is reduced, and in turn the energy in the arc is reduced. At the same time, the arc has less fibre to act upon, and hence less gas is generated. Finally, with a somewhat larger bore in which to expand, the gases are not as violently accelerated out of the cutout's open end.

The result: less energy, less flame; less violence, and less hazard. And while such performance is of special importance at the highest fault levels, this same reduction applies proportionately across the entire range of faults.



Arc Paths in Distribution Cutouts

For voltages up to 14.4 kv

XS CUTOUTS

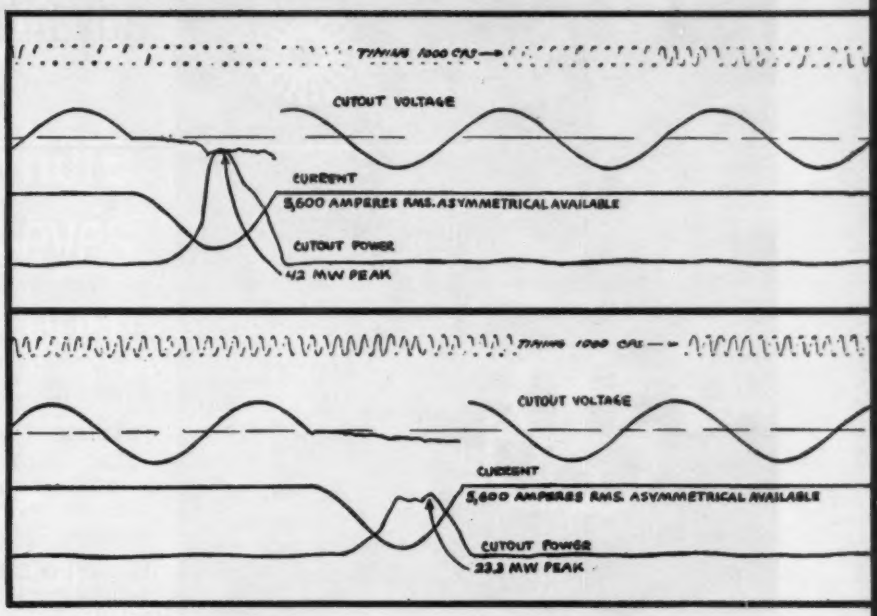
Open cutouts designed for use with LOADBUSTER®

This open cutout is designed for use on modern distribution systems to provide for the two performance factors of most concern: reliable interruption of the heaviest faults with minimum violence and to provide repetitive load switching capability. Available in Extra Heavy Duty and Ultra Heavy Duty styles with arc-shortening rod at 7.2 kv and 14.4 kv. (Also Heavy Duty styles at 7.2 kv, 14.4 kv, 25 kv, and 34.5 kv.) The XS Cutout can switch full rated loads up to 200 amperes with disconnect blade at 14.4 kv when used with LOADBUSTER, the portable loadbreak tool.

exhaust blast reducing the energy

Here's the proof:

This pair of oscillograms shows how "arc-shortening" reduces the arc energy. The upper oscillogram is taken from a test on an XS Cutout *without* an arc-shortening rod; the lower is *with* an arc-shortening rod. Note that the peak power—a measure of blast violence—is virtually cut in half, from 42 megawatts without the arc-shortening rod to 23.3 megawatts with the rod. But the available fault current being handled by the arc-shortening rod is exactly the same, 5600 amps rms asymmetrical. Note also that the maximum arc voltage has been reduced 50%. This is indirectly a measure of the reduced power in the arc.



For additional information: S&C Electric Company, 4427 Ravenswood Ave., Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.

S&C

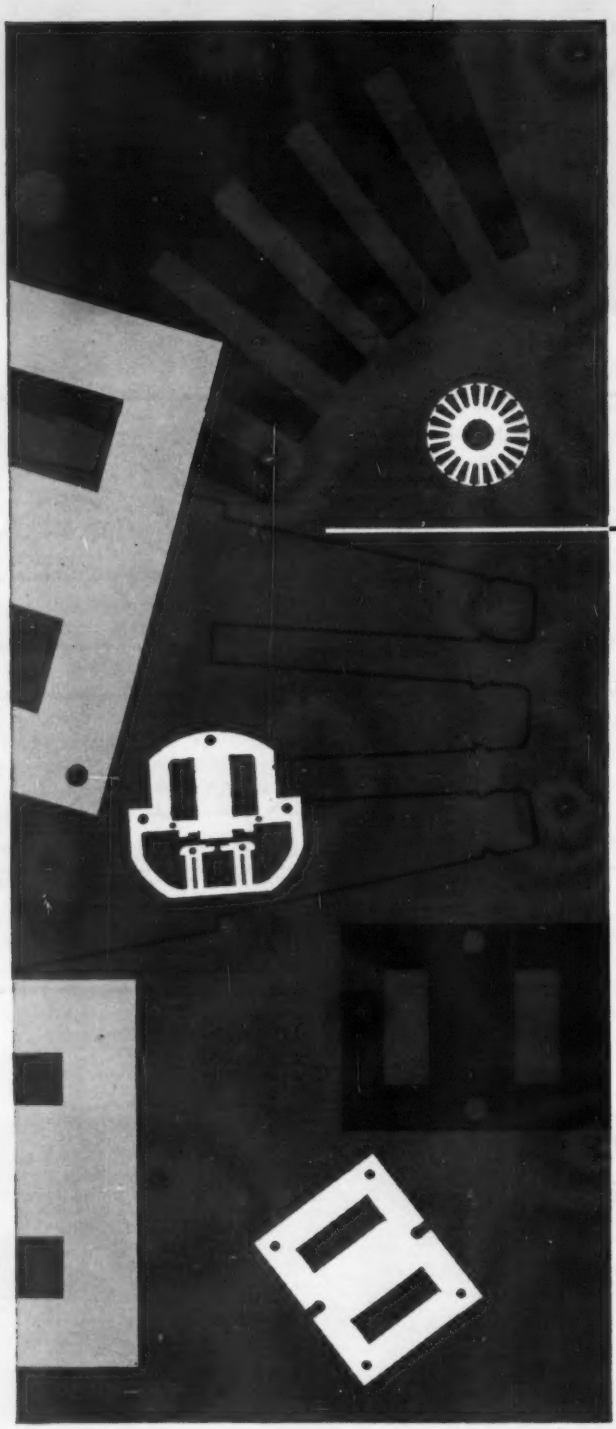
for voltages through 4.8 kv

POSITECT CUTOUTS

Enclosed cutouts with full load switching capability

The S&C Positect is the only enclosed cutout with full load switching capability, without external arc or exposed hot parts. Will switch up to 300 amperes with disconnect tube. Note interrupter attachment which permits full load switching. Designed and tested for closing against faults. In case of fault closing, all blast is directed away from operator.

Specialists in High-Voltage Circuit Interruption Since 1910



Armco DI-MAX M-15 gives you both design and production advantages

New steels are born at Armco

Where the low core loss of M-15 electrical steel is required, Armco's special DI-MAX provides unique advantages that permit design improvements and production efficiencies.

Armco DI-MAX M-15 offers you:

PUNCHABILITY—DI-MAX properties contribute to good die life and high productivity in the shop. Its uniformly high ductility enables you to produce punched laminations of any size and shape, yet retain low core loss.

ECONOMY OF COILS—You can use high production, continuous manufacturing methods because DI-MAX M-15 is available in coils. Ductile, annealed butt welds are within sheet gage limits—facilitate punching and core assembly.

GOOD FLATNESS—The flat, smooth surface of DI-MAX M-15 results in improved space factor and enables you to design for efficient performance.

BETTER PERMEABILITY—At high inductions this special Armco grade provides better permeability than the regular M-15 grade, further enhancing performance capabilities.

Use the outstanding magnetic and fabricating properties of Armco TRAN-COR DI-MAX M-15 in *your* products. For complete data on this cost-reducing, performance-improving Armco Electrical Steel, write to Armco Steel Corporation, 1739 Curtis Street, Middletown, Ohio.

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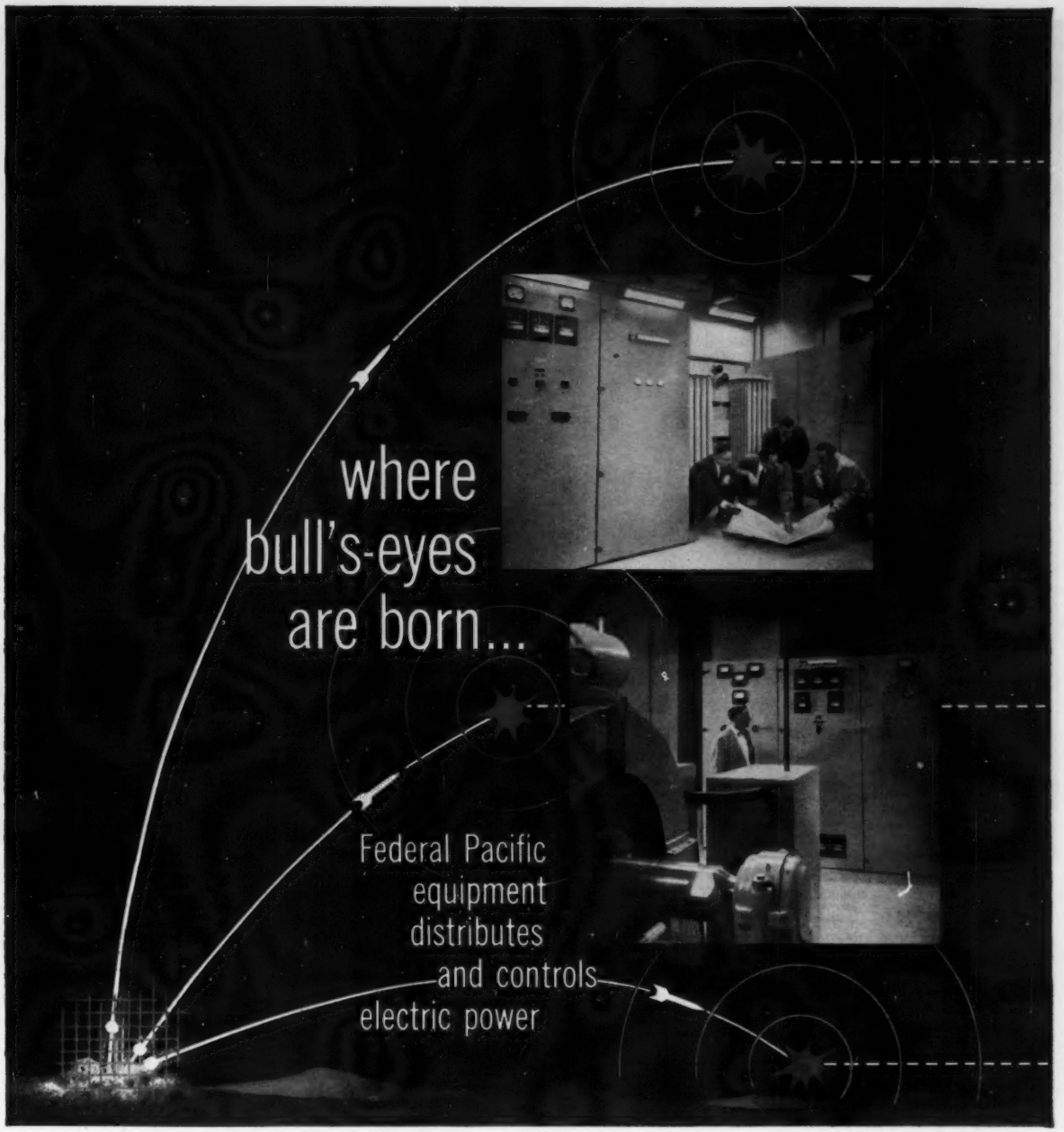

In a small town near Roanoke, Virginia, a crucial phase of America's missile program is underway. Here Thompson Ramo Wooldridge Inc. develops and tests auxiliary power systems that help keep deadly missiles on target. Here reliability and top performance are watchwords. We're proud that Federal Pacific equipment has been chosen to provide distribution and control of electric power for this vital project. Whether your business is missiles, motor cars or machine tools; when you specify Federal Pacific, you specify top quality and complete reliability. Federal Pacific Electric Company, General Offices: Newark 1, New Jersey.

Illustrations show part of Federal Pacific's installation at the Rocky Mount missile auxiliary power system test and development station. (Top) Inspecting control wiring blueprints of a Federal Pacific unit substation. (Left to Right) J. T. Jennings, Federal Pacific Field Engineer; J. Q. Peeples, Plant Engineer and J. F. Hatfield, Electrical Superintendent for Thompson Ramo Wooldridge Inc.; Peter Van Skiver, Engineering Field Representative for McConathy, Hoffman & Associates, Inc., of New York City. (Lower) Incoming line compartment showing Federal Pacific 15 kv 500 mva Air Circuit Breaker with field application panel for controlling a large synchronous motor.

FPE

FEDERAL PACIFIC ELECTRIC COMPANY

The Best in Electrical Distribution and Control Equipment

Reducing total installed costs is no heads or tails affair with the AMP electrical/electronic circuit terminating method. There's no clutter or extra material, no temperature problems, multi-step assembly or snarled-up inventory mess. The AMP method is simplicity itself—just the terminal and the tool that go together like the two sides of a coin—never one without the other.

Production rates with A-MP tools are astonishing—up to 4,000 finished wire terminations an hour, with but one A-MP automachine and one operator. As for precision, no other wire terminating method can match the assured uniformity and reliability of the A-MP terminal and tooling team—a team that turns out an endless parade of unexcelled terminations . . . all as identical as newly minted coins. There are no doubtful attachments, no hidden defects to slip by your inspection department. Speed, simplicity, uniform reliability—this means a lower installed cost per electrical circuit termination over all other methods. Nothing is left to chance with the AMP Cost Saving Method. You can bank on it.

Send for our new Cost Saving Brochure.

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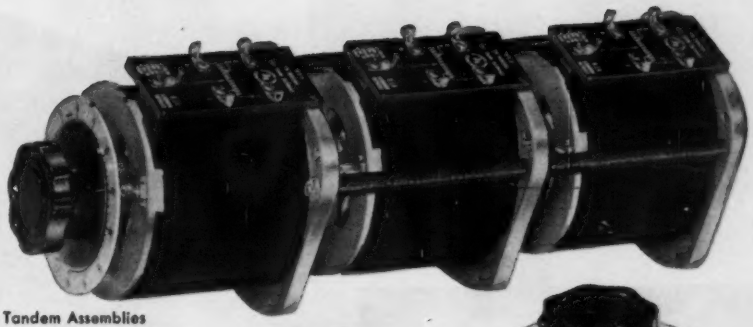
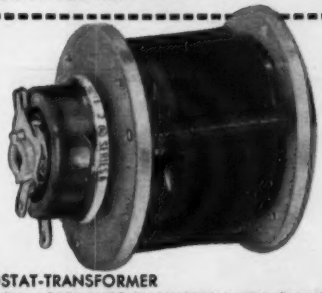
Enclosures for portable or fixed use.

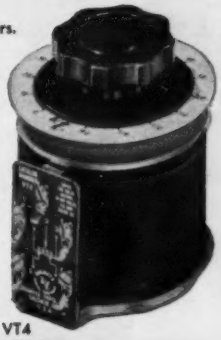


Tandem Assemblies in all three sizes of Ohmite Variable Transformers.

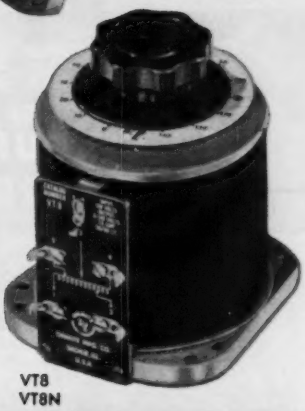


RHEOSTAT-TRANSFORMER TANDEM ASSEMBLIES. EXCLUSIVE WITH OHMITE

VT2
VT2N



VT4
VT4N



VT8
VT8N

OHMITE® "v.t." Variable Transformers Give a "Bonus" in Current Capacity

EXPANDED LINE—Ohmite now offers industry six basic models with current ratings sufficient to meet a large percentage of industrial applications. The new line includes enclosed units and tandem assemblies. Two models, VT2 and VT4, offer capacity greater than competitive units of comparable size and price. *An additional and sizeable "bonus" in current* is given in all sizes when the overvoltage feature is not required ("N" suffix, see below).

ADVANCED FEATURES—Positive current transfer achieved with direct brush to slip-ring, pig-tailed connection; table or panel mounting—on VT4 and VT8 sizes, adjustable shaft moves to brush or base side; interchangeable with other popular types both electrically and "mounting-wise"; durable rhodium plating on brush track for longer life.

SPECIALS ENGINEERED FOR YOUR NEEDS—Transformers can be modified to meet different requirements such as special shafts for nonstandard panel thicknesses, auxiliary switches, taps on transformer winding for fixed intermediate voltages, and motor drives for remote control or servo-operation. The only manufacturer in the industry concurrently producing power rheostats, tap switches, and variable transformers, OHMITE can also offer in-tandem combinations of these items.

BASIC MODELS (with overvoltage) All inputs 120 v ac*

MODEL VT2	MODEL VT4	MODEL VT8
Volts output: 0-120/132	Volts output: 0-120/140	Volts output: 0-120/140
Amps output: 1.5	Amps output: 3.5	Amps output: 7.5

BASIC MODELS (without overvoltage) All inputs 120 v ac*

MODEL VT2N	MODEL VT4N	MODEL VT8N
Volts output: 0-120	Volts output: 0-120	Volts output: 0-120
Amps output: 1.8	Amps output: 4.75	Amps output: 10.0

**Units available for 240-volt input also*

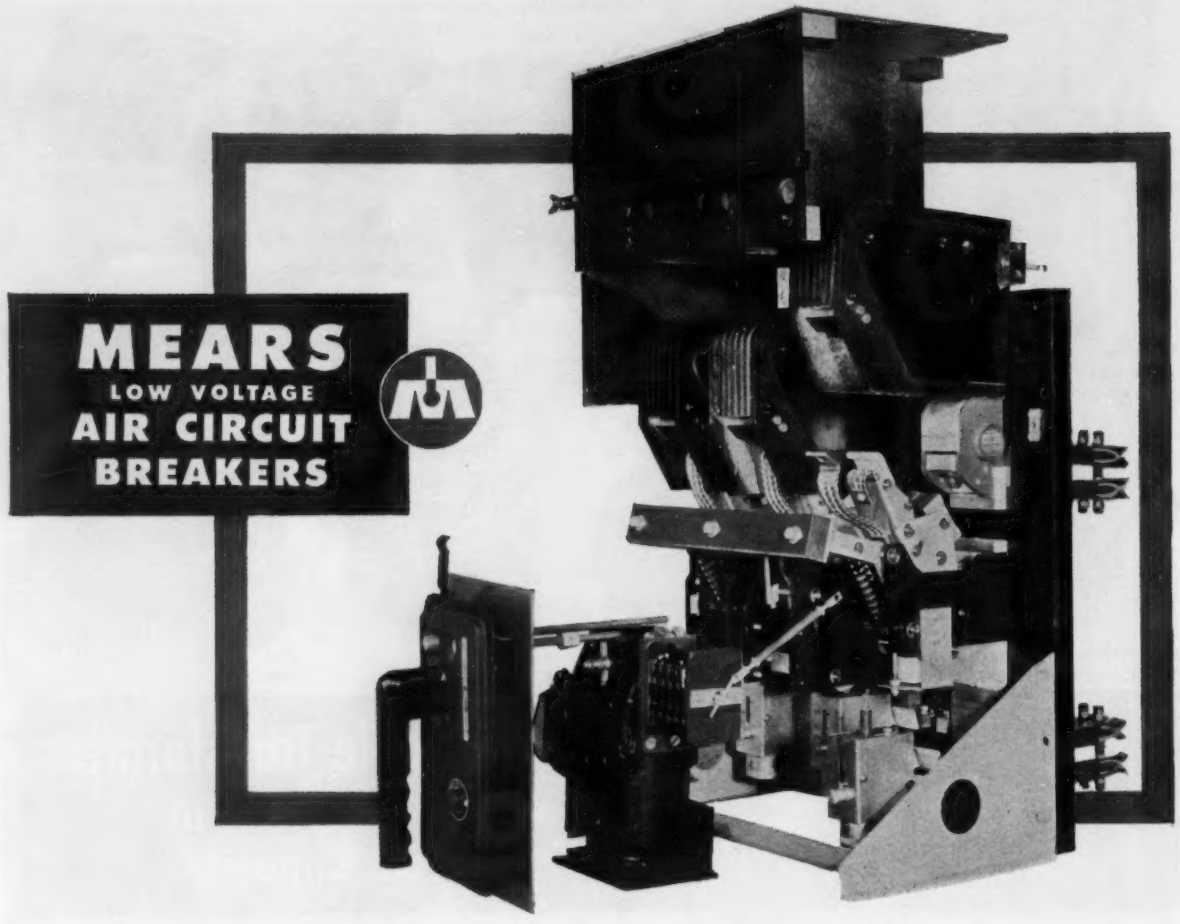
Write for Bulletin 151

Available from Ohmite Distributors or direct from factory

OHMITE® QUALITY Components

OHMITE MANUFACTURING COMPANY | **3614 Howard Street Skokie, Illinois**

RHEOSTATS RESISTORS RELAYS TAP SWITCHES R.F. CHOKES
VARIABLE TRANSFORMERS TANTALUM CAPACITORS DIODES



A circuit breaker must be 100% dependable

(or it is 100% worthless)

The dependability of a circuit breaker is something unique. It is built to handle a crisis that may never occur. Unable to flex its muscles regularly, its function is to rest in a state of inactive readiness for years on end. If it fails once it is a *total* failure.

There are two ways to check a circuit breaker's dependability. One is to assess its mechanical design in the light of an engineer's basic knowledge of electromotive and mechanical forces. Another is to look at the record. On both counts Mears invites the most searching inquiry. Many exclusive design features provide an exceptional margin of safety. As for the record—no Mears circuit breaker has ever failed, even after years of suffusion in the abrasive dust of cement mills or the corrosive fumes of chemical plants.

It will pay you to learn more about Mears low voltage air circuit breakers.

Mears circuit breaker features

- . . . Both electrical and manual operation.
- . . . Low operating temperature.
- . . . Sintered silver contacts.
- . . . Shockproof.
- . . . Vertical plane design.
- . . . Dustproof.
- . . . Operating torque with 300% safety margin.
- . . . Light tripping action.
- . . . Low maintenance.
- . . . Extra wide range of ratings (can be sized to job).
- . . . Only West Coast breaker manufacturer.
- . . . Fast Delivery.
- . . . Up to 75,000 Amp interrupting capacity.

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AIR CIRCUIT BREAKERS

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M. H. Gottfried, Mexico City
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Mears Electric Circuit Breakers, Inc.
Swan Island, Portland 17, Oregon

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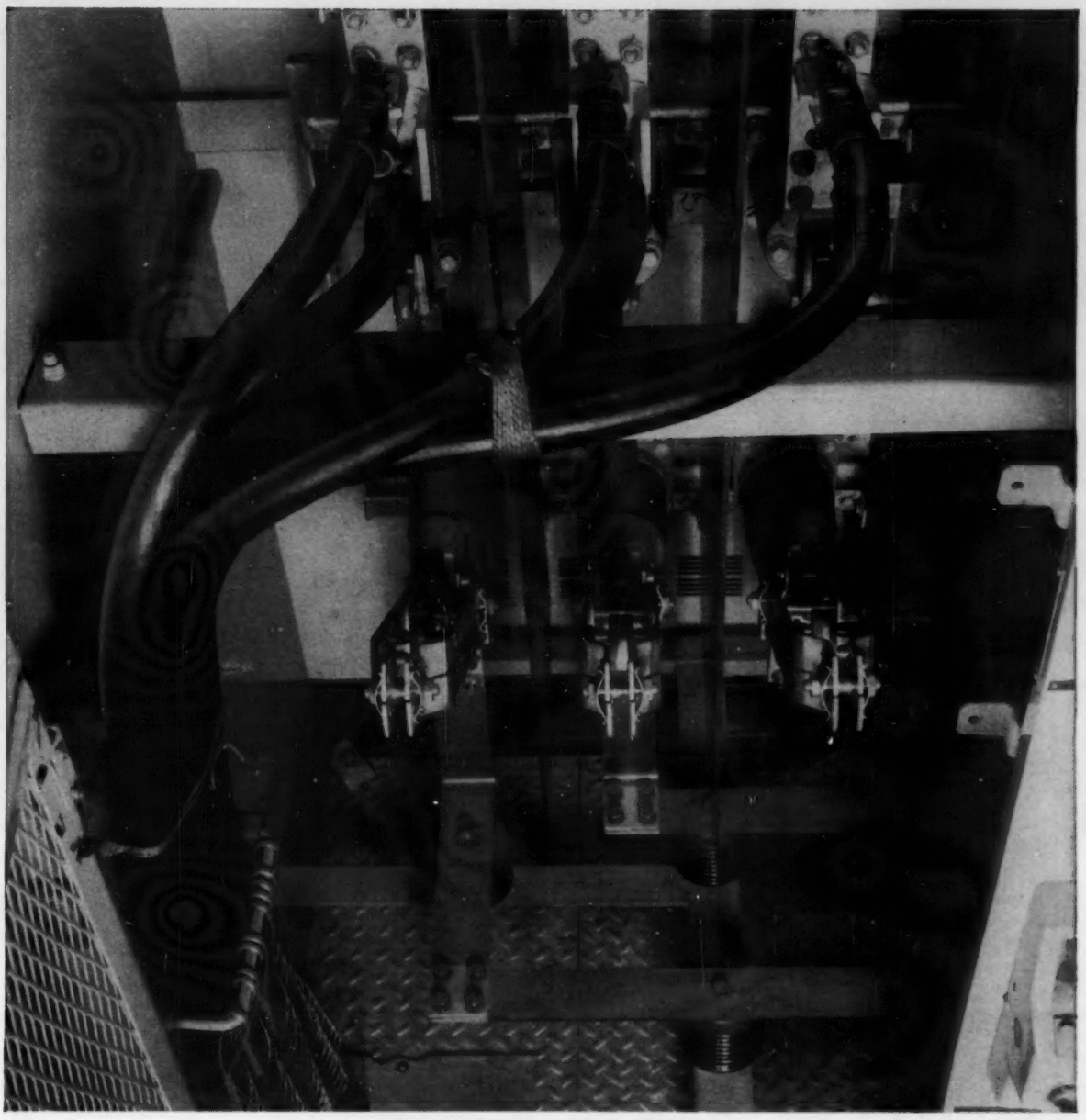

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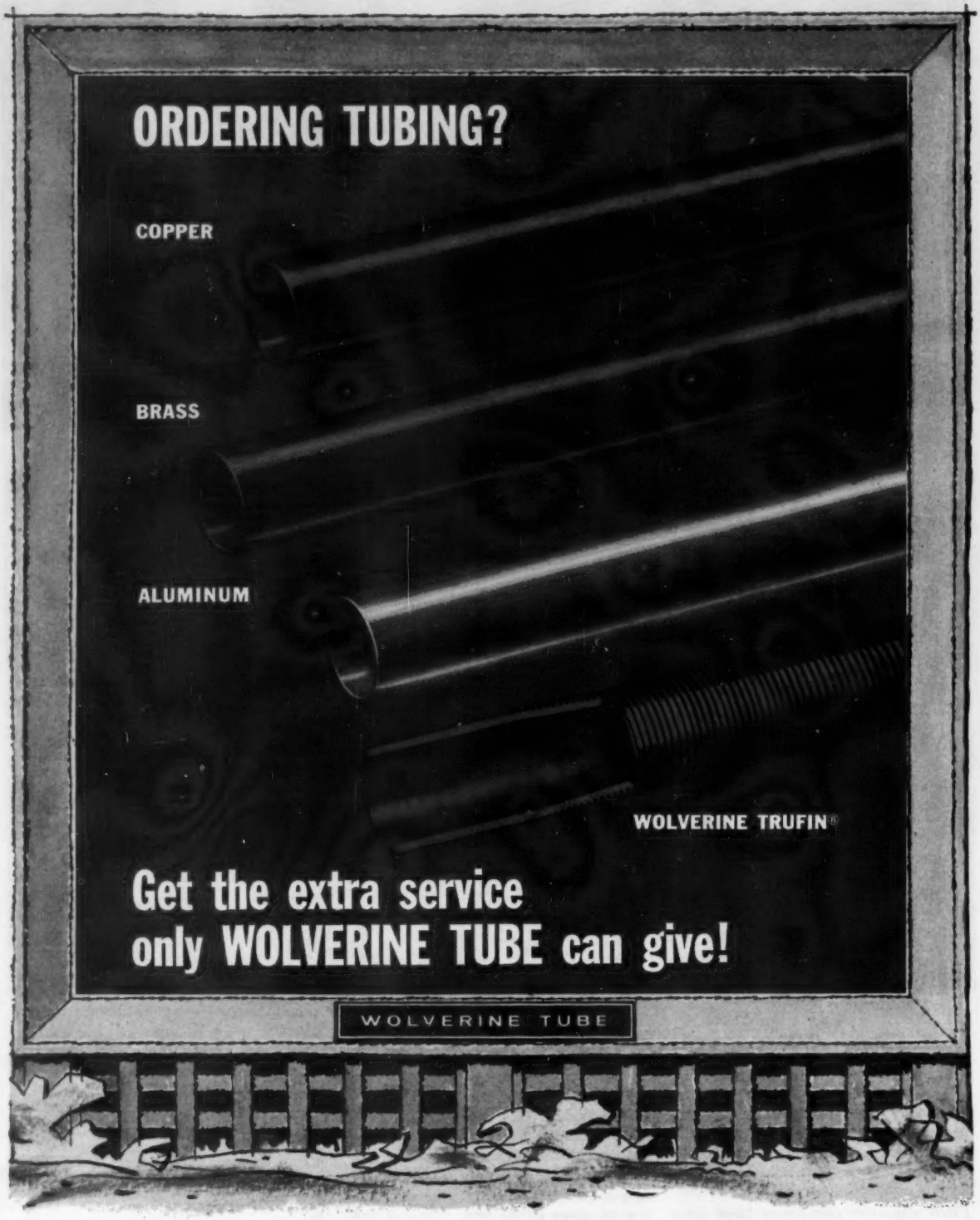

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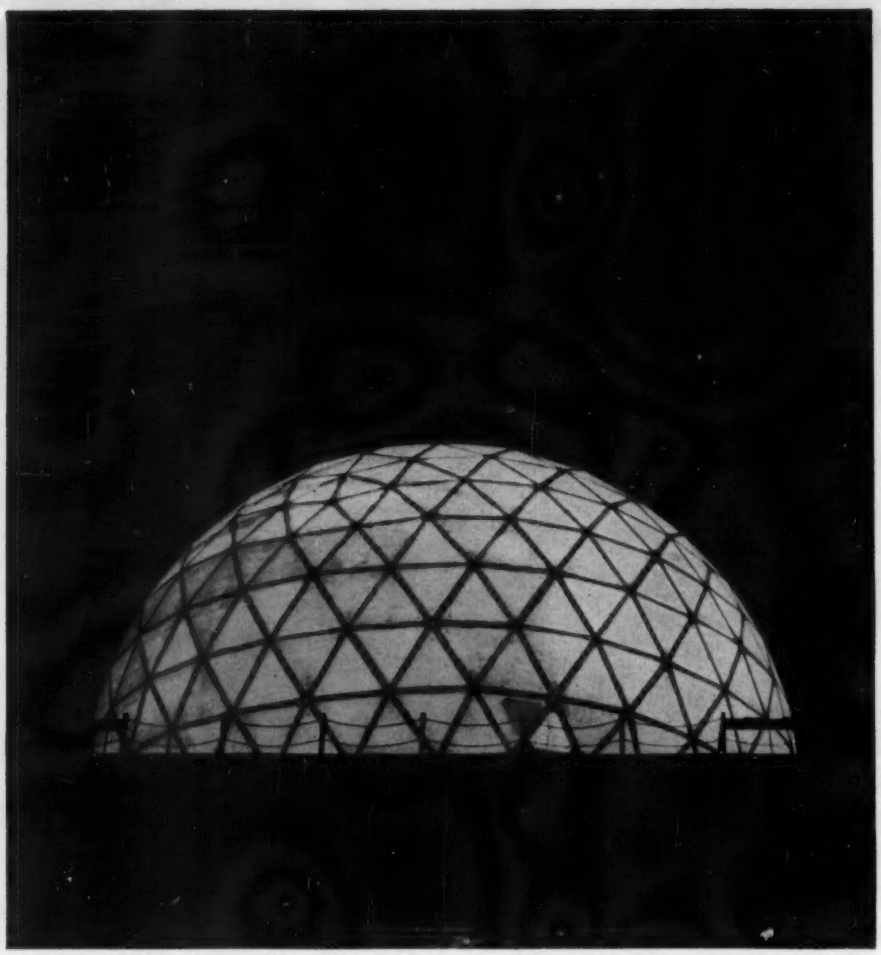
THE ARCTIC EYE THAT NEVER SLEEPS



This plastic radome houses a radar antenna constantly scanning the skies to detect the presence of aircraft. A line of these radars provides early warning of any threatening approach to the North American continent.

The Distant Early Warning Line is now on perpetual guard duty. Spanning the Arctic from Baffin Island to Alaska, this great system was conceived at the Lincoln Laboratory of M.I.T. and produced under the leadership of Western Electric.

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The obstacles were formidable. Conventional means of communication—telephone poles, cables and even line-of-sight microwave radio—weren't feasible. A complicated system had to be made to operate reliably in a climate so cold that outdoor maintenance is impracticable farther than a few hundred feet from heated habitation.

Whenever possible, Bell Laboratories engineers utilized well-proven art. But as it became necessary, they innovated. For example, they designed and directed the development of a new and superior radar which automatically scans the skies, pinpoints a plane and alerts the operator.

To reach around the horizon from one radar station to another, they applied on a massive scale a development which they pioneered—transmission by tropospheric scatter. Result: at a DEW Line Station you can dial directly a station more than a thousand miles away and converse as clearly as with your home telephone.

Bell Laboratories' contribution to the DEW Line demonstrates again how telephone science works for the defense of America.

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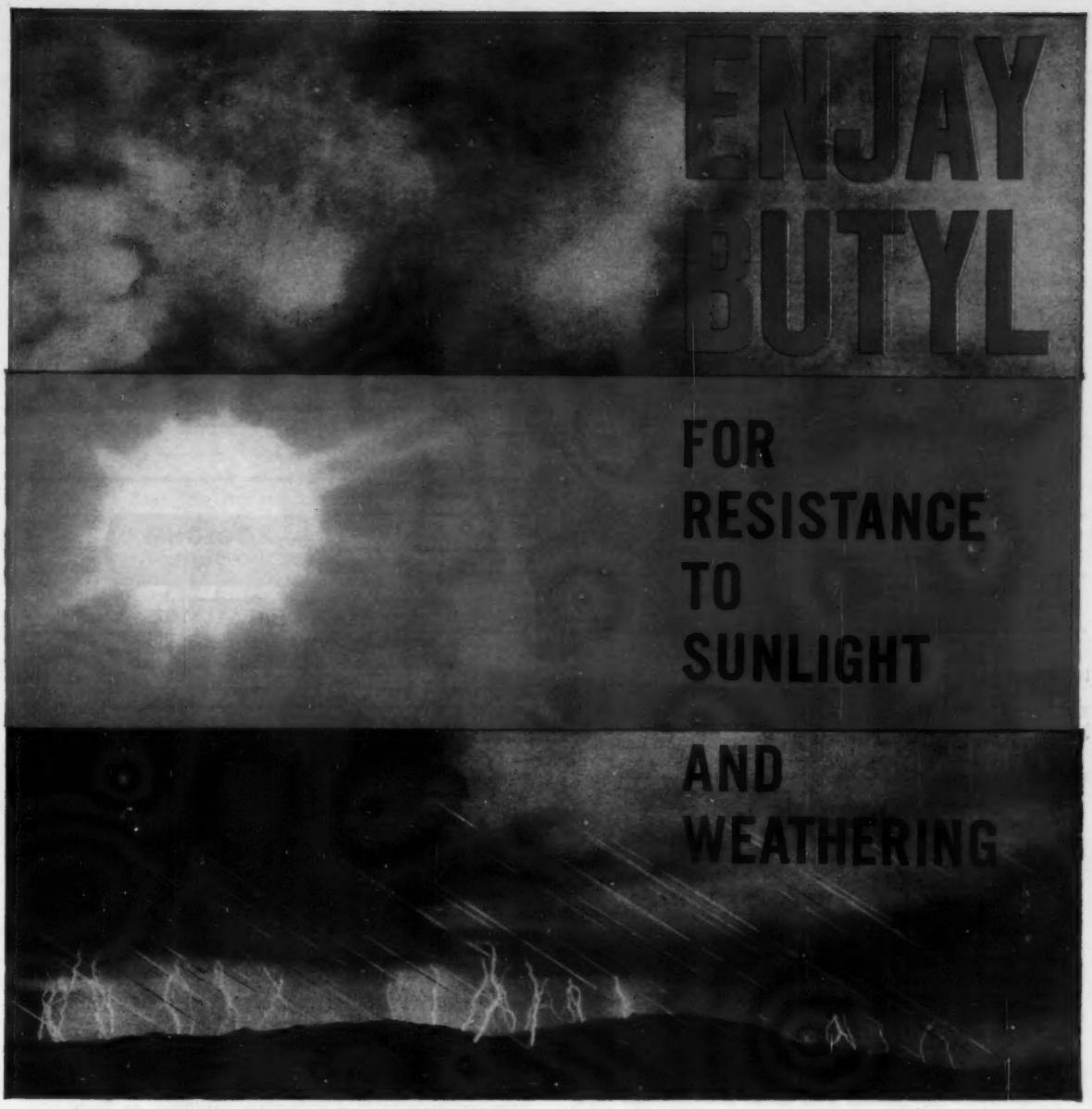

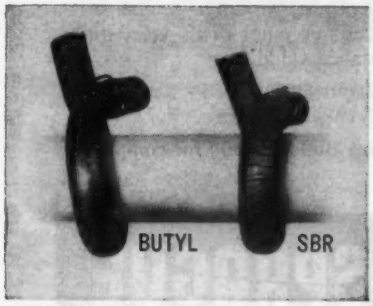

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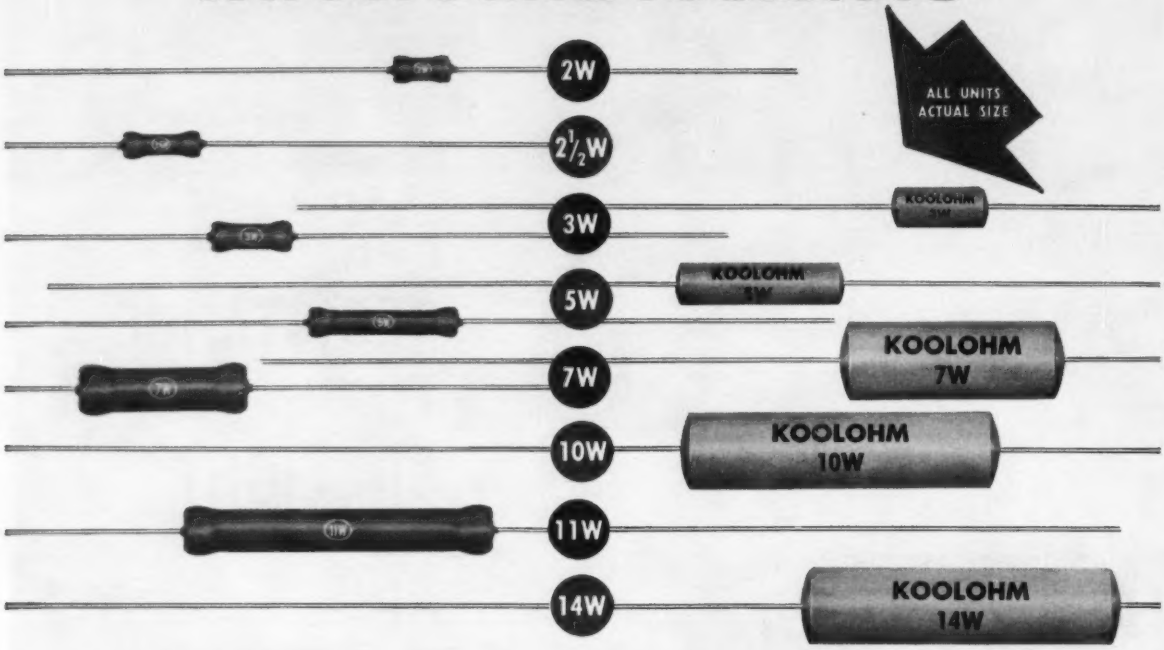

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Sprague's new improved construction gives even greater reliability and higher wattage ratings to famous Blue Jacket miniature axial lead resistors.

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A Salute to the American Institute of Electrical Engineers

It is a pleasure, both personally and officially, to bring to members of the American Institute of Electrical Engineers greetings and felicitations on the observance of your 75th anniversary. Anniversary observances are useful in that they encourage us to take an appraising glance at the past and to re-examine our plans and hopes for the future.

The AIEE may look with satisfaction and pride on its past. Together with its sister engineering societies, it has served to emphasize and to enhance the professional status of the engineer. It has cultivated and encouraged the application of science to the advancement of electrical technology. It has provided the means for cross-fertilization among electrical engineers and for the dissemination of information and ideas essential to the deepening and widening of the art and practice of electrical engineering. When it was founded 75 years ago, the world was in a period of transition between the gaslight era and the brightly lighted era of the incandescent bulb. Since that time, we have witnessed a swiftly accelerating technological revolution which has raised our standard of living, increased our productivity, and brought about the unprecedented division of effort whereby we spend less effort in producing goods than we do in providing services. The result has been the creation in the United States of a great industrial society characterized by a sustained eagerness to find better ways of doing things in order that it might continually improve the environment, health, and welfare of all of its citizens. Engineers and especially electrical engineers have played a crucial role in bringing all this about, and this anniversary provides an appropriate opportunity to salute them for their accomplishments.

James R. Killian, Jr.
Special Assistant to the President for Science and Technology

75 Years—
A Prologue to the Future

The Institute and Research

L.F. HICKERNELL
PRESIDENT AIEE

The Institute's role in the phenomenal progress made during the past 75 years is summarized by President Hickernell with highlights from reports and records of the AIEE and its affiliated organizations.

THE DIAMOND ANNIVERSARY of AIEE comes at the start of the Space Age, when a sense of eager anticipation of engineering achievement is prevalent everywhere. With this in mind, the committee planning the birthday celebration called our first 75 years a "Prologue to the Future." A society with no regard for its past will have little future worth remembering. Our members should be inspired by the Institute's great heritage, and the opportunity to augment it with their own contributions.

Even in research, for which we have no fund except for a share in Engineering Foundation, we have made very real contributions. Through the years, the Institute has provided stimulus and encouragement to research, has espoused its causes and recorded its progress. Here are a few illustrations of AIEE's role in research, gleaned from our prologue.

PAPERS AND TRANSACTIONS

PROBABLY the single greatest contribution to research by the Institute is its forum for presentation and discussion of papers; and its publication thereof in a permanent record for 75 consecutive years.

The 10th Annual Report[1] of the Council (which in 1901 became our Board of Directors) contains this statement:

> The 10 volumes of *Transactions* already issued form in themselves a very complete record of electrical progress during the life of the Institute. Many of the most important inventions and researches have first been made public under the auspices of this organization.

This statement is equally applicable today.

In the early days, papers were contributed voluntarily by prominent leaders in the infant industry. Currently, with many avenues for publication available to authors, the majority of papers are solicited or sponsored by the Technical Committees and several of the General Committees.

In 1957-58, there were 1,269 papers presented at 8 General and District Meetings; and 890 at 25 Special Technical Conferences, exclusive of those programmed at the National Electronics and Nuclear Engineering Conferences in which AIEE participates. The combined attendance at these 33 meetings was 26,808. In addition, uncounted thousands of papers were presented at 2,606 meetings of the 112 Sections, 67 Subsections, and 223 Technical Groups, with a total attendance of 137,373.[2]

President Houston (1893-95) once pointed out[3] that the electrical press "supplements the influence of the Institute because the press, unlike the Institute, cannot bring electrical workers together, but can only . . . disseminate the conclusions they have reached." The effect of bringing electrical workers together is apparent in the recorded discussions published with the papers in our *Transactions.* This practice was initiated at the first technical meeting in 1884, and has continued ever since. In many cases, the discussions are of as much value as the paper itself. At the 5th Annual Meeting, May 22, 1889, preprinting of papers for promotion of intelligent discussion was suggested by Past-President Edward Weston (1888-89). President Elihu Thomson (1889-90) agreed and added that written discussion also should be published.[4] Our *Transactions,* published annually from 1884 to 1957, contain 8,643 papers. Not all these papers, of course, are reports of research, but a surprisingly high percentage of them are. Quite possibly, these 121 books in the familiar blue and gold binding represent the most complete record in electrical science and engineering available in a co-ordinated series.

Before a research project is initiated, a search of this magnificent record should be mandatory. For this purpose, the six multiple-year indices are convenient. Years covered are 1884-1900, 1901-1910, 1911-1921, 1922-1938, and 1939-1949.

ENGINEERING SOCIETIES LIBRARY

THE INSTITUTE is the largest contributor to the support of the Engineering Societies Library, which is a silent partner in research throughout the country. In a recent year, it provided over 75,000 photoprints, and answered over 40,000 inquiries made in person, by telephone, or by mail.

The Library contains over 175,000 volumes, over 10,000 bibliographies, and subscribes to more than 1,500 periodicals. Among its special collections is the world-famous Latimer Clark Collection of 7,000 volumes of early electrical literature presented to the Institute on May 17, 1901, by Past-President Schuyler Skaats Wheeler (1905-06).[5] This now priceless collection was catalogued[6] with funds provided by Andrew Carnegie, and initiated his interest in providing a permanent home for the Engineering Societies.

Full text of address presented at General Session, AIEE Winter General Meeting, New York, N. Y., Feb. 2-6, 1959.

L. F. Hickernell is with the Anaconda Wire and Cable Company, Hastings on Hudson, N. Y.

INDEXING OF LITERATURE

YEAR AFTER YEAR, millions of dollars are wasted by duplication and repetition of research. At the same time, libraries are being filled to overflowing, and their growth is exponential. We are being smothered in our own product.[7]

We desperately need a central agency to code the scientific and enginering literature, and provide searches on a specific subject by mechanization. Unfortunately, the task is so stupendous and expensive that no one has been willing to undertake it. Since everyone would benefit, this is an area which profitably could be supported by both industry and Government.

The Institute recognized this need as early as 1894, as evidenced by the discussion of a paper entitled "Suggestions for an Index of Engineering Literature," by Prof. George D. Shepardson, University of Minnesota.[8] The discussion by 14 members recorded in 30 pages is one of the longest in our early *Transactions*.[9] In discussing the difficulty of indexing, President Houston pointed out that "the average index of the average book is almost worthless." He illustrated his observation[10] by " a little story of an index in a book under the caption: 'Earl of Chatham, his great mind, page 99'; and upon turning to page 99, all that was found about the Earl of Chatham's great mind was that he had said 'He had a great mind to pursue this line of policy to the end.' (Laughter)."

On December 20, 1894, Council appointed a Committee on Indexing Electrical Literature which reported on May 21, 1895, that the probable expense, estimated at between $16,000 and $30,000, would be too heavy for the Institute to bear.[11]

At long last, something is to be done about this deplorable situation. In the National Defense Education Act of 1958 (Public Law 85-864) recently passed by the Congress, Title IX directs the National Science Foundation to establish a Science Information Service which shall:

> 1. PROVIDE, or arrange for the provision of, indexing, abstracting, translating, and other services leading to a more effective dissemination of scientific information; and
> 2. UNDERTAKE programs to develop new or improved methods, including mechanized systems, for making scientific information available.

The immediate objective[12] is "to develop authentic information as to the extent these services are now being provided by private facilities engaged in the dissemination of scientific information, and to what extent the Federal Government should participate, either in the way of establishing a scientific information center or in providing funds in support of existing programs."

Apparently it took a Sputnik to get this 60-year-old idea off the ground!

Meanwhile, bibliographies continue to be our main guide to prior work. Their preparation early claimed the attention of the Institute. The second binding of the *Transactions* contained an "Index of Current Electrical Literature," consisting of 3,311 references.[13] Publication of this index continued in the two succeeding volumes. [14,15] The index was "compiled gratuitously by a gentleman too modest to have his name appear."

Several of our Technical Committees currently compile bibliographies on their specific subject. Of these, the most ambitious undertaking is the "Classified Bibliography on Insulated Conductors" covering English-language references[17] since 1930. This Bibliography employs a loose-leaf format, permitting annual supplements, and its references are classified (1) by years, (2) by publications, (3) by main subjects, and (4) by subsubjects. The technique lends itself to business machine card-indexing, and is adaptable to other fields.

STIMULATION OF RESEARCH

MANY RESEARCH PROJECTS have been suggested, or expedited by the Institute; at first by the Council, later by the Technical Committes. Only a few will be cited.

The first recorded suggestion is contained in the Inaugural Address on September 20, 1893, by President E. J. Houston (1893-95), in which he suggested that the AIEE take up and complete the unfinished work of the 1893 International Electrical Congress in the development of practical units of light and illumination.[18] To accomplish this, he proposed (a) that the membership of the standing committee on Units and Standards be increased, and (b) that subcommittees be constituted in the colleges which possess the necessary physical or electrical laboratories "to carry on, without expense to the Institute, the necessary investigations."

On November 15, 1893, the President reported[19] that the "following gentlemen have agreed to undertake the work of determining the standard of light and of illumination":

Prof. Edward L. Nichols	Cornell University
Prof. Charles R. Cross	Massachusetts Institute of Technology
Thomas A. Edison	Edison Laboratory
Dr. F. A. C. Perrine	Leland Stanford Jr. University
Dr. Louis Duncan	Johns Hopkins University
Prof. F. B. Crocker	Columbia College
Prof. R. A. Fessenden	Western University of Pennsylvania

On April 24, 1895, Prof. Fessenden reported that his University had appropriated $800 for the experimental work, the results[20] of which led him to recommend an acetylene standard.

On January 19, 1897, the Units and Standards Committee recommended that the amylacetate Hefner-Alteneck lamp should be adopted temporarily as standard of luminous intensity or candlepower, under standard specifications. The Committee recommended also that the Lummer-Brodhun photometer screen be adopted for measuring the mean horizontal intensity of incandescent lamps, the lamp being rotated about its vertical axis at a speed of about 2 turns per second. It was recommended[21] further that the mean spherical

candlepower of a lamp should be used as far as practicable.

In 1926, one of the most extensive projects was initiated[22] by the Committee on Power Transmission and Distribution with its appointment of a Subcommittee on Lightning "to investigate lightning and its relation to transmission lines." Under the auspices of this Subcommittee, manufacturers and utilities co-operated in a series of lightning measurement studies which extended over a decade. The Subcommittee also reviewed and indexed more than 425 papers of which over 200 were reproduced in the "AIEE Lightning Reference Book, 1918-1935," published in July 1937. The edition of approximately 5,000 copies was sold out in 9 months. Because of increased printing costs, publication of a supplementary volume was abandoned in favor of a "Lightning Reference Bibliography, 1936-1949," published in April 1950 (*Special Publication* S-37), which contains 754 classified references.

STUDENT RESEARCH

IN HIS INAUGURAL ADDRESS on June 27, 1898, President A. E. Kennelly (1898-1900) outlined a plan by which the Institute might secure the co-operation of the various college laboratories in pursuing a systematic course of electrical research, the results of which could be incorporated in the permanent record[23] rather than filling theses books to lie on neglected shelves.

Council appointed the following committee to prepare suggestions:

Dr. A. E. Kennelly, Chairman

Prof. W. A. Anthony	Dr. Samuel Sheldon
Dr. Francis B. Crocker	Charles P. Steinmetz
Dr. Cary T. Hutchinson	Prof. Elihu Thomson

In November 1898, the Committee prepared a circular[24] which was sent to all electrical engineering departments of American colleges submitting a list of 27 proposed investigations, of which 20 were accepted by the colleges. Some of these subjects continue to engage investigators 60 years later; for example:

(2) The influence of sustained high temperature upon the dielectric strength of insulating materials

(22) The dielectric strength of different substances employed for insulating at different frequencies

(24) The dielectric strength of vapors of different substances

Currently, the Institute encourages undergraduate student research[25] through its prize awards (cash and certificate) for best papers at the Branch, District, and Institute level. In addition, the Members-for-Life Fund Committee provides a trip to the Summer General Meeting for first prize winner in the District Student Prize Paper competition.

ENGINEERING FOUNDATION

THE ENGINEERING FOUNDATION was originated in 1914 when Ambrose Swasey indicated his desire to make a "gift to engineering in general, and for conduct of research in particular." Mr. Swasey's gifts, which totaled over $800,000, were augmented by other contributions. In 1956, a bequest of $400,000 from the estate of Edwin H. McHenry brought the total to a little over $1.5 million. United Engineering Trustees administer the endowment fund for the Founder Societies.

Over the years, the Foundation has contributed upward of a million dollars to more than 125 different projects. At present, it has at its disposal approximately $100,000 annually. Because of its very modest resources, the Foundation Board generally has employed the so-called "seed money" technique; that is, has made its grants contingent upon contributions of considerably larger amounts from other sources.

Of the seven projects totaling $493,585 sponsored by AIEE under the Engineering Foundation procedure, three have been on dielectrics research. In addition to contributing to our knowledge of this important subject, these projects assisted in developing a unique group of specialists who studied under Past-President J. B. Whitehead, (1933-34) and became leaders in the dielectrics field. At a time when development of our young scientists and engineers is of paramount importance, this effective means of developing talent should be utilized to a far greater extent.

The active sponsorship of research under the Engineering Foundation usually is traceable to the interest and endeavor of one individual. For example, the 3-year, $61,450 research project on Soil Thermal Resistivity Characteristics is primarily the result of the energetic activity of Chairman M. H. McGrath of the Insulated Conductor Committee (1953-55).

Of all the fields served by foundations (or funds, or trusts, or whatever you prefer to call them), none has a greater potential of service to humanity and to the Nation than our own field: engineering. The professional engineering societies have demonstrated their ability to administer co-operatively funds for research. What a pity this medium has not attracted more philanthropists! This thought recurs whenever I read of a comparatively unimportant, sometimes seemingly frivolous, project supported by one or another of our large Foundations.

CO-OPERATIVE BASIC RESEARCH

IN THE ELECTRICAL INDUSTRY, basic research (as differentiated from applied research and development) is carried out by a relatively few large manufacturing companies and utilities, commercial and endowed laboratories, Government agencies, and universities. A considerable portion of university research is financed by foundations or the Government.

The time is fast running out when small segments of the industry can survive solely by applied research and development. Modern industrial basic research is expensive, the annual cost being from $28,000 to $56,000 per scientist[27] (including his supporting services), according to a 1956-57 survey. It is considered that a small unit is likely to be ineffective.

On this basis, the only possibility I see for small industry's future survival in the free-enterprise system

lies in the organization of co-operative basic research laboratories by various branches of industry. For example, confronted with probable future demand for insulated cable for 345-, 460-, 500-kv, or perhaps higher operating voltages, the cable industry could well consider establishing a central laboratory to conduct *basic* research on insulating materials. Applied research and product development would be conducted as at present by the individual manufacturers.

This purely personal observation is made without investigation of legality. However, if co-operative research laboratories of this type are illegal, consideration should be given to changing the laws, in the interest of maintaining a technological supremacy for the welfare of our Nation.

U. S. PATENT OFFICE

RESEARCH seldom is undertaken solely for the sake of obtaining patents, but there is little question that they play an important role in our free-enterprise system. Consequently, a fair and equitable Patent Law, and administration of it, is an essential cog in our economic machinery.

The Patent Office received considerable attention from our Founders. At the organization meeting, May 13, 1884, after the election of officers, a communication was read from C. J. Kintner, chief examiner, Class of Electricity, U.S. Patent Office, pointing out the deplorable and unsanitary working conditions of his staff of 11 persons, housed in 2 rooms. After discussion, the meeting[28] passed two resolutions; the second one reading:

> RESOLVED: That the Chair appoint a Committee of 3 who shall take such action as they may deem proper, with a view to calling the special attention of Congress to the needs of the Patent Office, especially in regard to the Class of Electricity.

Of the 11 papers presented at the first technical meeting, October 7-8, 1884, one was entitled, "The Patent Office: Its Relation to Inventors and Its Needs," by C. J. Kinter.[29] Similar papers followed in 1885[30] and 1886.[31] On December 20, 1887, a paper was presented on the "Revision of the Patent Law," by Arthur Steuart, general legal counsel, National Electric Light Association.[32] During the discussion, Mr. R. M. Hunter suggested[33]:

> . . . The final fee should not be over $5 to print the patent, and *all of the reference patents*, etc., are to be printed upon the face of the patent so issued

The Patent Office did not adopt this practice until 1947, some 70 years later!

NATIONAL BUREAU OF STANDARDS

THE INSTITUTE took an active part in urging the formation of the National Bureau of Standards. On March 28, 1900, Council appointed a committee[34] to encourage "the establishment by the Government of a Standardizing Laboratory." On September 26, 1900, it was reported that members of the Committee had appeared before Congressional Committees. However, owing to the press of business at the close of the session, Congress[35] failed to pass the bill.

In his inaugural address on October 24, 1900, President Carl Hering (1900-01), reporting on the Paris Exposition of 1900, pointed out that government electrical standardizing laboratories had been established by England, Germany, France, and Russia. The United States alone, among the large countries, had practically nothing of the kind.[36]

On November 23, 1900, the Institute passed a resolution strongly endorsing the bills to establish the National Standardizing Bureau and recommending[37] their passage by Congress. This was followed by another resolution on January 9, 1901, urging the House Committee on Rules to fix an early date[38] for consideration of its bill.

On May 21, 1901, Council[39] reported:

> The Committee continued its work during the year and up to the date when the bill . . . passed in Congress. Not only was a large amount of correspondence carried on by this Committee in furtherance of the bill, but members of it visited Washington and appeared in its behalf before the Congressional Committee.

The Institute continues to support the work of the Bureau through its six-member Advisory Committee to the National Bureau of Standards.

POST-GRADUATE TRAINING

PAST-PRESIDENT F. B. Jewett (1922-23), the first president[40] of the Bell Telephone Laboratories, once said, "Next to having no research department at all in an industry, I can think of but one greater evil; namely that of having a research department staffed by second-rate and essentially incompetent men." Anyone engaged in the administration of research can heartily subscribe to this statement.

The Institute performs an outstanding service in education. It is essentially a post-graduate school[41] in that it has the necessary components:

Classrooms—Section, District, General Meetings

Seminars —Round-table Discussions
Technical Conferences
Technical Committee Meetings

Faculty —Speakers and Authors of Papers

Textbooks—*Electrical Engineering* (monthly)
Transactions (annual), consisting of:
I —*Communications and Electronics* (bimonthly)
II —*Applications and Industry* (bimonthly)
III—*Power Apparatus and Systems* (bimonthly)
Special Publications (symposia)
Standards

Many of the larger Sections conduct educational courses which would do credit to any university.

One of the great values of a professional society such as our Institute is that it brings together men of all specialties in the electrical and allied arts. Through membership in AIEE, the graduate can be assured of a perpetual supply of information on all branches of electrical engineering. Although each new development

creates new specialists, it makes us more dependent upon each other because of the interrelation of the several arts and sciences.

In addition to technical advancement, opportunities for professional and personal friendships also develop in committee work of the Section, District, General, and Technical Committees. Committee work teaches cooperation among colleagues of divergent viewpoints but equal status. When the need arises to obtain assistance in solving a problem, or in undertaking new projects involving technologies other than one's own, contacts with fellow professionals made in the Institute may prove invaluable.

The Institute's educational value often finds appreciation in employers of engineers. They consider that the Institute aids them in training and developing their young men, and in keeping their experienced engineers informed and abreast of the times.

RESEARCH – A PROLOGUE TO THE FUTURE

PRESIDENT Frank J. Sprague (1892-93) opened his inaugural address on June 6, 1892, with the statement[42]:

> It is a trite but mistaken saying that electricity is in its infancy. It dropped its swaddling clothes when Morse sent the first telegraph message. It put aside dresses and pinafores when the dynamo machine and arc light were invented. The incandescent lamp, the telephone, the art of welding, the transformer, are incidents of buoyant youth. The modern electric motor and electric railway mark a vigorous manhood.

There is no gainsaying the brilliance of the accomplishments cited by Sprague, and it is hardly surprising that he failed to realize the precociousness of his personified electricity. In the intervening 66 years, Sprague's electric railways have come and gone, and we have witnessed a continuing parade of impressive electrical developments, including radio and television. Some are still in the research laboratories, not yet ready to take their places in the line of march. Others are just started, or awaiting attention by researchers.

Our National Archives Building bears an inscription from Shakespeare reading "What is past, is prologue" (The Tempest, Act II, Scene I). This quotation, to use a popular translation by a Washington taxicab driver, means: "You ain't seen nothin' yet!"

New York City, in addition to its eminent position in the field of engineering, is proud that in its surrounding area may be found several diversified research centers, each unsurpassed in its field. Here, in the Engineering Center of the world, it takes no omniscience, nor courage, nor optimism, to extend to the entire electrical industry the Institute's anniversary slogan:

75 Years—"A Prologue to the Future"

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Characteristics of Twin Conductor Arrangements

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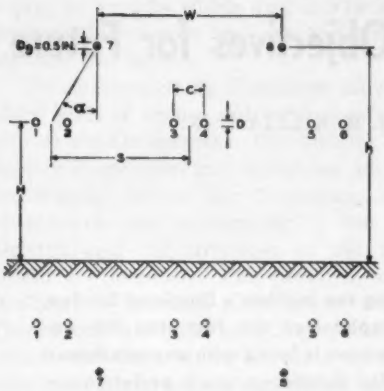
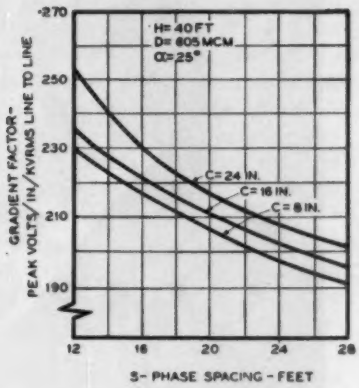


◀ Fig. 1. Typical conductor configuration.

Fig. 2. Effect of intragroup spacing on gradient factor. ▶



AMONG the advantages of twin conductors are the reduction of the surface gradient and of the inductive reactance of the phase conductors. The typical conductor arrangement of the single circuit line with twin conductors is shown in Fig. 1. *C* is the intragroup spacing; i.e., the distance between the centers of the twin conductors of each phase.

Single conductor lines with conductors of large diameter may be preferred on certain cross-country rights of way where higher surface voltage gradients may be tolerated, whereas twin conductors with optimum intragroup spacings *C* could then be used for limited sections of the line in congested areas where nearby housing makes noise-free arrangements mandatory. In order to isolate the noise generated on the single conductor line section from the twin section, it would be necessary to install *RI* chokes. Similar measures may even be considered for certain sections of lines with different spacings *C*, which are completely of the twin- or bundle-conductor type, as would be the case for extrahigh operating voltages.

For horizontal arrangement of conductors (Fig. 1), the maximum gradients appear on the middle phase and they occur, for all practical purposes, when the voltage on that phase is a maximum. Therefore, and because of symmetry, the maximum voltage gradient need be calculated only for one of the twin conductors of the center phase; it then becomes

$$E_{max} = \frac{4\,Q_3}{D} \cdot \left(1 + \frac{D}{C}\right)$$

After finding Q_3 from the basic equation of the electrostatic charge distribution, we obtain the maximum voltage gradient expressed in statvolts per inch, if *C* and *D* (Fig. 1) are in inches. Dividing the maximum gradient by *V*, expressed in statvolts, we obtain E_{max}/V statvolts per inch, per statvolt; but the units of this expression are also volts per inch per volt.

Inasmuch as the maximum peak voltage gradient is desired, it is more convenient to use root mean square (rms) values. If the rms values are given in terms of the line-to-line voltage in kilovolts, the maximum gradient factor may be expressed as

$$F = E_{max} \cdot \sqrt{\frac{2}{3}} \cdot 10^3 \text{ peak V per inch per line-to-line kv}$$

This factor has been plotted (Fig. 2) for various phase spacings and for intragroup spacings *C* between 8 inches and 24 inches when steel re-enforced aluminum cable (ACSR) conductors of 605,000 circular mills are used. Fig. 2 shows that reducing *C* from 24 inches to 16 inches and to 8 inches reduces the gradient factor and produces the desired results.

In addition to *C*, the phase spacing *S*, the conductor size (expressed by the conductor diameter *D*), as well as size and arrangement of ground wires influence the magnitude of the gradient factor. Larger conductors and wider separation between phases lead also to smaller gradient factors. Inasmuch as the middle conductors are the critical ones, it would be worthwhile to consider equalization of all phase conductors by using larger conductors and/or smaller intragroup spacing *C* for the middle phase only. In order to provide good shielding and in order to keep cost down, the designer will not have much choice in the selection of groundwire location and its height *h* above ground. (It may be mentioned that the effect of the groundwire on the gradient factor is so small that it need not be considered). However, an increase in conductor height *H* leads also to an increase in the gradient factor.

Digest of paper 58-509, recommended by the AIEE Transmission and Distribution Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Great Lakes District Meeting, East Lansing, Mich., May 5-7, 1958. Published in AIEE *Transactions*, vol. 77 pt. III, 1958, pp. 721-25.

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Ross Photos

Engineering Past Expands Objectives for Future

J. R. KILLIAN, JR.

Commemorating the Institute's Diamond Jubilee, Mr. Killian emphasizes the fact that the engineering profession is faced with unprecedented requirements for excellence, peak performance, and public service—the past having been "a prologue to the future."

THIS, your year of Diamond Jubilee, is the appropriate occasion for emphasizing that the "past is prologue," that the engineering profession now faces new and unprecedented requirements for excellence, for peak performance, and for public service. Given the record of the past, the objectives of the engineering profession today can be no less than these:

To employ the arts and science of engineering with zest and audacity to achieve a world in which people everywhere may lead free and abundant lives;

To extend the recognition that engineering is a creative activity that augments man's dignity and understanding and that affords him intellectual adventure of the highest order;

To stress those aspects of engineering which enhance the quality of our society, which encourage individuality in the midst of standardizaton and which enhance man's excellence and dignity as well as his productivity;

To recognize that outstanding accomplishments in engineering appeal deeply to the hopes and aspirations of men everywhere, and contribute to the prestige and good will of nations;

To recognize and to seek ways of meeting the rising requirements for excellence in the education, the work, and the professional standards of the engineer;

To work diligently and imaginatively to create a sound and correct public understanding of the work and function of the engineer as a professional man;

To break down any barriers which tend to separate the engineers from the scientists, the humanists, and the social scientists;

To use the great opportunities inherent in engineering and science to promote international understanding and good will;

To insure that engineering, in the light of today's urgent need, contributes its maximum to the defense of the United States and the Free World, and to recognize that survival depends upon the vigor and effectiveness of our science and technology.

I pause to cite these objectives and ideals because I believe that they are inherent parts of the engineering profession's mission and obligation today. At a time when our society is challenged persistently by hostile forces of great and growing strength, we must seek peak performance in every aspect of our national life, and especially must we set our sights high in the great professions of science and engineering.

I also wish—by way of introduction and explanation—to say a word about my present assignment.

WORK OF THE SCIENCE ADVISORY COMMITTEE

THE ESTABLISHMENT of the Office of the Special Assistant to the President for Science and Technology and the reconstitution of the President's Science Advisory Committee in November 1957 were part of the general effort to strengthen American science and engineering and to relate them more effectively to policy-making. Other action has been taken in other parts of the executive branch, in Congress, in international organizations, and wherever our scientists do their work. Much of what the Committee has been able to accomplish in the past year has been possible because of the climate of understanding and co-operation at various levels within the Government as well as on the part of outside organizations and groups, including private industry and our colleges and universities.

In the beginning, there were certain misconceptions about my role and that of the Committee. We have no operational responsibilities. Neither do we have any responsibility to decide policy. My function and that

Essentially full text of 75th Anniversary observance address made at the AIEE Winter General Meeting, New York, N. Y., Feb. 1-6, 1959.

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of the Committee is to provide answers to questions raised by the President, to undertake assignments for him of an advisory kind, to mobilize the best scientific advice in the country, and to make recommendations to him in regard to ways by which United States science and technology can be advanced, especially in regard to ways by which they can be advanced by the Federal Government and can best serve the Nation's security and welfare.

The members of the Committee are representative of those fields of science and technology currently important to the Government. The director of the National Science Foundation and the science advisor of the State Department sit with the Committee, and the director of research and engineering of the Department of Defense and the chairman of the Defense Science Board are members. The president of the National Academy of Sciences is ex officio a member of the Committee, and the out-going president of the International Council of Scientific Union has been a member. Thus, the viewpoints of both the national and international communities of science are represented. A portion of the Committee membership rotates, thus bringing in fresh points of view and fields of science hitherto unrepresented.

The Science Advisory Committee is organized into a group of panels which include both regular committee members and other engineers and scientists selected from outside the ranks of the Committee. Some of these panels have standing responsibility; others are called together for ad hoc assignments. The panels are responsible to the Science Advisory Committee but they draw into our councils a wider range of scientific and engineering experience and expert advice than can be provided by a single committee.

The Committee also serves as a Board of Consultants to me as a special assistant to the President. This relationship is highly important. One man should not try to represent science nor to provide expert advice in a variety of fields. I draw on the full range of advice and experience of the Science Advisory Committee and its panels. The Committee has the prerogative, when it chooses, of reporting directly to the President. As special assistant, I also have, in addition to the Advisory Committee and its panels, special consultants, task forces, and staff. At the present time, the Science Advisory Committee and my office have more than 50 scientists and engineers serving part time.

It is important to note that the Special Assistant for Science and Technology is invited to sit in on meetings of the National Security Council and the Cabinet and, when appropriate or requested, to present the views and findings of the Science Advisory Committee. The President has thus created a mechanism to bring objective scientific and engineering advice to the top levels of Government in a manner that reaches across all agencies and departments and yet can serve each of them.

And now against the background of my experience in education and in my present assignment, let me mention three aspects of engineering which seem to me to warrant special attention today.

First, we need to bring more clearly into focus the image of the engineer in the minds of our citizens. Despite all of the efforts of our engineering societies and councils, this image is neither sharp nor accurate. For example, the lack of any clear distinction between the scientist and engineer has been manifest in all the recent public discussions of our national strength in science and technology. Some of the great engineering accomplishments of our time have come to be loosely tagged, in the public mind, under the generic title of science. This confusion is not in the interest either of science or engineering, and the scientists are as unhappy about the confusion as are the engineers.

During the past few months, there has been much speculation as to why a significant drop occurred this Fall in the number of students entering engineering schools. Recently, I have been corresponding with engineering educators, in an effort to understand why it happened. Let me summarize the statement of one engineering college administrator who expressed a general reaction: He feels strongly that one of the serious problems in getting qualified young people to go into engineering schools is the great stress today on science, "with the almost total omission of painting the role of the engineer in society for the general public . . . The development of nuclear power, the development of the atomic submarine, the development of satellites . . . are always spoken of as scientific achievements when, of course, they are major engineering feats." Over the long run, if we are to "draw into engineering education those students who are eminently fitted and who can make major contributions, we have a major educational job to do . . . This requires a well-conceived and well-executed continuing plan of painting an accurate picture of what the engineer does and of the kind of liberal training for a modern technological society which our very best engineering schools provide."

I do not advocate any less emphasis on science and its importance. I do urge a comparable emphasis on the role and importance of the engineer.

I submit that the great engineering societies have a responsibility and opportunity to deal aggressively with this problem. It is important to the future strength of the engineering profession that they do so.

Second, there is a related problem of finding ways whereby the engineering profession brings its great resources to bear in our national policy-making. It is in the national interest that it do this with the same degree of effectiveness that science, law, medicine, and the other great professional groups have found ways of doing. The Engineers Joint Council and the engineering societies have, of course, made great strides in achieving this desirable objective. These efforts need to be fully supported if engineering is to deal effectively with the problems involving the place of the engineer in our society, and if it is to bring to bear effectively the great resources of engineering in our national councils and in the national service.

The plan for the great new Engineering Center here in New York, ground for which will be broken this year, is a heartening demonstration of the capacity of the engineering profession to muster its resources to achieve a common goal, to enhance the services of the professional societies and to symbolize appropriately the importance of the engineer and the unity of the engineering profession.

The third need I would stress is for a major advance in engineering education in the United States. Although our schools of engineering and our institutes of technology present a notable record of achievement and command envy on the part of other nations, and although we have some of the finest schools of engineering in the world, we still face the requirement that these institutions be further strengthened if they are to educate the kinds of engineer which our advancing technology and our industrial society will require.

CONCERN FOR ENGINEERING EDUCATION

ONCE AGAIN, we have a problem of public understanding. We have been witnessing a great surge of interest in science education; we need an equal concern for engineering education. We have seen in the past few years how effective has been the needed mobilization of public understanding and support on behalf of medical education. We must achieve a comparable national effort on behalf of engineering education, where inadequacy can be as perilous to the national welfare and safety as inadequate medical education.

Within our engineering schools there are many problems to be met, and, happily, there is a great ferment today in these institutions and a widespread recognition of the opportunities which exist to adapt engineering education to the needs of our advancing technology.

Until now our chief reliance in engineering education has been on undergraduate preparation—a system which has not universally risen above the training of technicians. Although there will long continue to be an appropriate and essential place for the really professional 4-year undergraduate engineering program, it must be supplemented by expanded graduate study in engineering.

Many industries have been ahead of many colleges in recognizing this need. As a consequence, they have evolved training programs of their own to carry their engineers beyond the levels of a 4-year undergraduate education. If we had the graduate school capacity to handle these men, it would be more appropriate and advantageous for them to receive their advance training in the university, rather than in industry. The engineer, no less than the scientist, can benefit from an atmosphere of uncommitted research, and our technological advance would be more certain if top graduates of 4-year engineering courses proceeded on to graduate study.

The strengthening of graduate study in engineering will serve to enrich the undergraduate program. The research point of view and some research experience can advantageously be made available to able undergraduates.

STRESS ENGINEERING SCIENCES

THERE IS ALSO the well-recognized need to lay greater stress on the engineering sciences. In addition to strengthening the older and long-recognized engineering sciences such as mechanics and thermodynamics, we need to go further and define more clearly those syntheses which are emerging as new engineering sciences, as, for example, solid-state technology and communication theory. Still other new subjects are coming into importance, such as magneto hydrodynamics and systems analysis. In order to achieve these new syntheses and develop these new courses, it will be necessary for engineering schools to encourage the development of faculty members with a new orientation in learning and attitude.

Some engineering schools have been experimenting with new curricula which depart from the customary 4-year undergraduate program followed by graduate study. Such alternative patterns should be encouraged, especially for more gifted students. The curriculum which permits a continuous program starting with the junior year and carrying a student on to the graduate years without any discontinuity may possess real advantages. With the freshman and sophomore years constituting the qualifying period, such continuous programs beginning with the junior year could be of 3 or 4 years' duration.

There is a growing opportunity for the delineation of converging fields—the bringing together of engineering with relevant fields of science and social science. The widening concepts of communications provide a good example. The United States needs engineers who have the understanding and the orientation to accept assignments and be effective in foreign service both for industry and for Government agencies operating internationally.

In the ferment and innovation and strengthening, which is now taking place in engineering education, electrical engineering has played a leading part. Courses in electrical engineering have long stressed mathematics and the engineering sciences, and in the last several years there have been notable changes in electrical engineering curricula in the direction of achieving a more fundamental approach with less compartmentalization. Something over a year ago, representatives of more than 100 electrical engineering departments joined together at my institution for an intensive curriculum workshop, giving special attention to the critical examination of new concepts in the education of electrical engineers. The success of this 10-day effort has stimulated a follow-up workshop on materials in electrical engineering education, to be held at the Case Institute of Technology with the support of the National Science Foundation during this coming summer. What has taken place and is taking place in electrical

engineering is an augury of the kinds of changes that may serve to enrich other fields of engineering.

In placing this much emphasis on the engineering sciences, I do not mean to imply that we should seek to educate all of our engineers to be research engineers. There is continuing need to recognize in our engineering schools the importance of the "synthesizing" engineers—those "who combine technical training with a broad knowledge of public policy and social problems, who not only design a highway, a waterway, a flood-control project, but who can also perceive and allow for the social readjustments—the benefits as well as the cost—of the new enterprise."

In all of these manifold ways we must achieve a deepening and broadening advance in the education of engineers if engineering is to achieve a professional quality and status comparable to that of medicine or law. We will not have solved our engineering manpower problem until we educate more engineers who unmistakably fulfill our society's standards of true professional excellence; men who have a profound understanding of their specialty, coupled with a broad and human culture. The development and growing numbers of this kind of highly educated engineers will serve to make engineering the profession it must be if it is to attract and hold its proper share of high talent.

The enlarged concept of engineering education which I delineate involves even deeper interrelationships between engineering and science and the identification of new areas of symbiotic association between engineering and the humanities and social sciences. We must move toward a new degree of articulation, a fusion of physical technology with social technology, a closer interaction of postdoctoral, graduate, and undergraduate studies, infused with the spirit and example of research at all these educational levels. Through such means our engineering institutions can accelerate the achievement of a program which turns out engineers who can, while achieving mastery of their specialty, avoid the easy, narrow rut of "excessive expertism" and go on to demonstrate, as engineers, leadership in human affairs—the capacity to use and shape technology as a powerful instrument for enhancing the quality of our society and for contributing to the solution of the great human problems of our time.

SATISFACTION IN PAST ACHIEVEMENTS

LET ME CONCLUDE by paraphrasing a paragraph of the recent report, "Strengthening American Science" of the President's Science Advisory Committee:

> As America approaches the decade of the 1960's, it can take reasonable satisfaction in its past scientific and technological accomplishments. Thoughtful men now see another role for science and engineering—a new and creative role that is still only dimly grasped. Science and engineering are common languages, understood the world over. By exchanging scientific and engineering viewpoints and working on common scientific and engineering problems—as exemplified so admirably in the International Geophysical Year, the two International Conferences on the Peaceful Uses of Atomic Energy, and the great engineering congresses which are periodically held—men of all nations may be drawn closer together. The endless frontiers of science and engineering now stretching to the stars can provide rich opportunities for men to seek a common understanding of the natural forces which all men must obey and which govern the world in which all men must live together.

On the walls of the Library of Congress is an inscription borrowed from a poet of another century: "Too low they build, who build beneath the stars." What better thought to keep before us as we view the future of this great society and of the engineering profession?

Outer-Space Use for Police Belt Radio

A pocket-size radio receiver designed originally to make earthbound man a "walking radio station" found a new role in the Atlas satellite.

A pair of all-transistor receivers—a modification of the RCA "Personalfone" two-way radio unit used by policemen, plant guards and others—helped relay back to earth President Eisenhower's Christmas message from outer space, according to Radio Corporation of America.

The special radio system for the Atlas satellite was developed for the U. S. Army by engineering specialists at RCA's Astro-Electronic Products Division, Princeton, N. J. The relay system provided seven channels for teletypewriter transmissions or one channel for voice communications.

The compact 10-ounce receivers in the 8,800-pound satellite were under control of ground stations which employed "souped up" 600-watt RCA "Carfone" base station transceivers. The "Carfone" is an RCA-developed unit which provides two-way communications between the truck driver and his home base, roving highway police and their headquarters, the taxi driver and his garage.

The flawless manner in which the airborne receivers operated was all the more remarkable considering the tremendous blast-off surge of the Atlas from its Cape Canaveral launching pad and the ensuing 17,000-mile-an-hour pace around the globe.

"Carfone" transmitters at a ground base transmitted a coded signal to the pocket-size receivers in the Atlas which in turn, activated a tape recorder and the President's voice was transmitted back to "Carfone" receivers on the earth.

The President's original message later was erased from the recorder in the Atlas, retransmitted from earth and played back again through the same coded signal system.

Theory and Practice of Soil Densification

H. F. WINTERKORN

THE THERMAL RESISTIVITY of soils is an important factor in the economy of systems of buried electric power cables. This resistivity is a function of the volume fractions of the solid, liquid, and gaseous phases of which soils are normally composed, and of their structural arrangement. Inasmuch as the solid phases usually possess lower thermal resistivities than the liquid and gaseous phases and, because the latter are greatly affected by external factors such as weather and topography and, hence, are subject to cyclic variations, the volume proportion and the structural arrangement of the solid soil constituents determine the maximum theoretical thermal resistivity of a soil. The dry densities of soils are often used instead of the volume proportions of solids. An increase in dry density by one pound per cubic foot results in an average decrease of thermal resistivity of 3 per cent. Soil systems, as found in nature or as obtained by normal backfilling practices, are usually neither at their most loose nor at their densest possible state. Between these two states, there is normally a difference of about 36 pounds with the natural state often having a density of about 12 pounds above the most loose. This indicates the potentialities of decreasing the thermal resistance of soils by means of better and more appropriate compaction methods.

Soils vary over a wide range in composition and resultant physical properties. At one extreme of the range are the granular, cohesionless sands and gravels; at the other extreme are clays of great water affinity and well-developed cohesion in dry and moist state. Because the granular, noncohesive soils differ greatly from the cohesive soils in magnitude as well as in type of resistance to mechanical forces, the most effective methods for their densification are also distinctly different. Knowledge of the densification behavior of the extreme types permits interpolation for proper treatment of the intermediate types.

In first approximation, the granular constituents of noncohesive soils may be assumed to possess spherical forms. If such particles are also of the same size, the theoretically possible types of packing and the resulting bulk densities of the particle assemblies can be found by application of the laws of symmetry. This the crystallographers have done and much can be concluded from their work that is of interest as regards the types of packing possible in the case of uniform spherical sand and gravel particles. Thus, cubical packing of spherical sand particles in which each particle is symmetrically contacted by six neighbors, results in a bulk density of about 87 pounds per cubic foot, while rhombohedral packing in which each particle is contacted by 12 neighbors, results in a bulk density of about 123 pounds per cubic foot. The theoretical maximum and minimum densities correspond quite closely with values actually obtained with uniform sand and gravel particles.

Without special packing effort, relatively high bulk densities can be obtained by using particles of different sizes; this, however, is achieved by increasing also the amount of internal surface per unit volume of the system. The thermal discontinuity existing on internal surfaces and interphases has a tendency to increase thermal resistivity and this may counterbalance the lowering in thermal resistivity gained by the over-all increase in bulk density. There is also the problem of segregation of particles of different sizes during transportation and placing.

Densification of granular noncohesive materials is best achieved by vibratory methods which have the advantage that a large number of compactive efforts can be packed into a minimum of time. For greatest effectiveness, however, the frequency of vibration must be a function of the particle size, decreasing as the latter increases.

The densification of cohesive silt and clay soils is governed largely by the amount, geometry, and physicochemical character of the specific surface of the solid-soil constituents. The specific surface of clays, i.e., the surface per gram, is of the order of magnitude of 10^5 cm^2. For easy compaction, this specific surface must be lubricated with water. The better the lubrication the less compactive effort is required, but also the less is the percentage of solids in the compacted volume since the thicker lubrication films hold the solid particles farther apart from each other. For each compactive effort per unit volume, there is an optimum moisture content that results in greatest volume percentage of solid constituents. This optimum moisture content shifts to lower values with increasing compactive effort while the volume proportion of solids also increases. There exists, however, the danger of overcompaction when the water of lubrication employed is lower than the capacity of the soil to absorb water energetically. If overcompacted, a soil will swell and lose density under normal environmental conditions. For cohesive soils, vibratory compaction is relatively ineffective. More adequate methods are tamping and rolling. However, vibratory compaction may be used for thin layers and for moisture contents that are a few percentage points above the plastic limit of the cohesive soils.

Digest of paper 58-871 recommended by the AIEE Insulated Conductors Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Buffalo Summer General Meeting and Air Transportation Conference, Buffalo, N. Y., June 22-27, 1958. Scheduled for publication in AIEE *Power Apparatus and Systems*, 1958.

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Surge Transfer through 3-Phase Transformers

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ALTHOUGH a low-voltage circuit, connected to the system by a transformer, has no direct exposure to lightning, lightning surge voltages can be produced in this circuit as a result of surge voltage impact on the high-voltage side of the transformer. Even though a lightning arrester is connected on the high-voltage side of the transformer, surge voltages transferred to the low-voltage side can be dangerous especially to lower BIL equipments such as rotating machines and dry-type transformers.

It is the purpose of this article to formulate equivalent circuits which can be used to determine the surge voltage transferred electromagnetically to the other transformer windings. Lightning arresters are assumed to be connected to the terminals of one of the transformer windings and, therefore, the lightning arrester discharge voltage is directly applied to this transformer winding. Because of the various types of load which can be connected to the transformer windings, in general, no attempt is made to evaluate any individual case critically. Rather, it is the purpose of this article to present in a compact and usable form, equivalent circuits for three-winding, 3-phase transformers which can be used subsequently for any specific problem where the exact nature of the load on the transformer terminals is known.

To simplify the presentation and anaylsis of surge transfer, the primary is defined as the transformer winding to which the surge is applied regardless of the comparative voltage ratings of the winding. For convenience, the other two windings are denoted as the secondary and tertiary.

Table I. Constants for Equivalent Circuits Used To Determine Electromagnetic Surge Transfer through Three-Winding Transformers. Single-Phase Applied Surge.*

Bank Connection										Maximum Voltage**	
Primary	Secondary	Tertiary	K	A	B	D	F	G	M	E_2/N_1E_1	E_3/N_3E_1
Wye‡	Wye‡	Wye‡	1	1	0	1	0	1	1	1	1
Wye§	Wye+	Wye+	$\frac{2}{3}$	1	$\frac{1}{3}$	1	0	1	1	$\frac{2}{3}$	$\frac{2}{3}$
Wye§	Wye+	Delta	$\frac{2}{3}$	1	$\frac{1}{3}$	3	$\frac{1}{2}$	$\frac{1}{2}\sqrt{3}$		$\frac{2}{3}$	$\frac{1}{\sqrt{3}}$
Wye§	Delta	Delta	$\frac{1}{\sqrt{3}}$	$\frac{1}{3}$	$\frac{1}{3}$	1	0	1	1	$\frac{1}{\sqrt{3}}$	$\frac{1}{\sqrt{3}}$
Delta	Wye+	Wye+	$\frac{1}{\sqrt{3}}$	3	$\frac{1}{3}$	1	0	1	1	$\frac{1}{\sqrt{3}}$	$\frac{1}{\sqrt{3}}$
Delta	Wye+	Delta	$\frac{1}{\sqrt{3}}$	3	$\frac{1}{3}$	3	$\frac{1}{2}$	$\frac{2}{3}\sqrt{3}$		$\frac{1}{\sqrt{3}}$	$\frac{2}{3}$
Delta	Delta	Delta	$\frac{2}{3}$	1	$\frac{1}{3}$	1	0	1	1	$\frac{2}{3}$	$\frac{2}{3}$

*Multiply the B constant by two for a 2-phase applied surge.

**Assumes Z_2 and Z_3 are resistors. Maximum voltage is same for a 1- and 2-phase applied surge.

†The neutral can be grounded or ungrounded.

‡Grounded.

§Ungrounded.

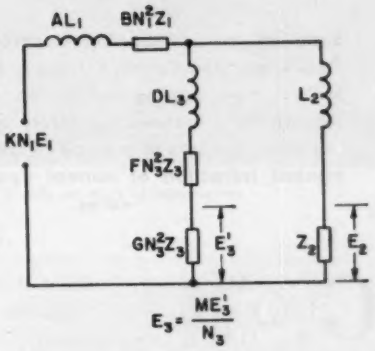

Fig. 1. General equivalent circuit to determine electromagnetic surge transfer through three-winding transformers indicated in Table I.

E_1, E_2, E_3 = crest magnitude of the surge voltage at the primary, secondary, and tertiary terminals, respectively.

E'_3 = crest magnitude of surge voltage at the tertiary terminals referred to the secondary winding.

N_1 = ratio of secondary-side line-to-line voltage to the primary-side line-to-line voltage for three-winding transformers.

N_3 = ratio of secondary-side line-to-line voltage to the tertiary-side line-to-line voltage.

L_1, L_2, L_3 = equivalent inductances of a three-winding transformer referred to the secondary-side of the transformer. In the equivalent inductance circuit, L_1, L_2, and L_3 are connected to the primary, secondary, and tertiary terminals, respectively.

Z_1 = surge impedance of line connected to the primary terminals.

Z_2, Z_3 = impedance connected to secondary and tertiary terminals, respectively.

An analysis of three-winding, 3-phase transformers to determine the surge voltage transferred electromagnetically to the secondary and tertiary terminals resulted in the equivalent circuit of Fig. 1. Table I gives the values of the constants used in Fig. 1 for a specific bank connection and also presents the maximum voltage which can appear at the secondary and tertiary terminals if Z_2 and Z_3 are resistors and E_1 is a square wave.

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Dresden Nuclear Power Station

A Look at the Electrical Features

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Some of the outstanding electrical features of Commonwealth Edison's Dresden Nuclear Power Station, now nearing completion, are described. Among these features are safety systems fortifying other systems to provide reliable safeguards against infraction of normal operating procedures.

GENERAL DESIGN DESCRIPTIONS of the 180,000-kw Dresden Nuclear Power Station (Fig. 1) being designed and constructed by General Electric Company (GE) for Commonwealth Edison Company using a nuclear reactor of the dual-cycle boiling-water type have been presented at many engineering society meetings. These descriptions have covered the structural, mechanical, and nuclear design aspects of Dresden and, in particular, usually have focused on items of interest that are different from conventional power plants. The purpose of this article is to present a description of some of the electrical features of this plant that also are different from our conventional fossil fuel fired electric generating stations.

The plant is being built on a 950-acre site (Fig. 2), about 47 miles southwest of Chicago, Ill., where the Kankakee and Des Plaines Rivers join to form the Illinois River. Associated with Commonwealth Edison in building the largest all-nuclear power plant now under construction in the United States, with money entirely financed by private industry, is the Nuclear Power Group, Inc., consisting of American Electric Power Service Corporation (formerly American Gas and Electric Service Corporation), Central Illinois Light Company, Illinois Power Company, Kansas City Power & Light Company, Pacific Gas and Electric Company, Union Electric Company, and Bechtel Corporation (the only company not a utility).

These seven companies and Commonwealth Edison Company are contributing $15 million of the total contract amount (Fig. 3) for research and development in return for all the engineering information connected with building and operating the plant. Bechtel, under contract with General Electric, is also the engineer–constructor, providing the design services for the conventional portion of the plant plus all the construction services.

The fixed contract price of $45 million provides that GE has a complete "turnkey" responsibility. In addition to the design, construction, and training of Commonwealth Edison Company employees, General Electric has the responsibility for fuel loading, start-up, and supervising the operation of the plant during the testing and demonstration period that is required to insure that the unit is ready to fulfill its place as a dependable part in the Commonwealth Edison system (Fig. 4).

The dual-cycle boiling-water type reactor, as a result of the fissioning in the reactor vessel of the 65-ton core of uranium dioxide fuel (Fig. 5), will supply saturated steam directly from the steam drum to the turbine at 1,000 psi. The hot water that was separated from the primary steam in the drum will be pumped through four secondary steam generators to form secondary steam at 500 psi. The reactor and nuclear components are housed in a 190-foot diameter spherical containment vessel; the other buildings are of conventional design.

AUXILIARY POWER SYSTEMS

BASICALLY, the design must provide reasonable assurance that the health and safety of the public will not be endangered by operation of the reactor. To satisfy this fundamental requirement, electrical safety systems fortifying or "backing up" other systems are duplicated throughout to provide reliable safeguards against infraction of normal operating procedures, operating errors, equipment malfunctions, or other contingencies. As an aid to attain this philosophy, five sources of auxiliary power (Fig. 6) are being provided to insure continuity of plant operation. In the event of the failure of all five power sources, the "fail safe" design of the controls will safely shut down the plant. (When the reactor safety system is not energized, the reactor is shut down, or scrammed, by the rapid insertion of the 80 control rods.)

Normal 4,160-volt auxiliary power is being furnished by two 10,000-kva auxiliary transformers with one transformer being fed from the generator at 14,400 volts with General Electric forced-air-cooled isolated-phase bus duct and the second auxiliary transformer supplying power from the Commonwealth Edison 138-kv transmission system through the 138-kv switchyard (Fig. 7). Either transformer can supply full-load auxiliary power.

In case of loss of either of the two main auxiliary transformers, low-voltage relaying automatically transfers the affected bus to the other transformer. This re-

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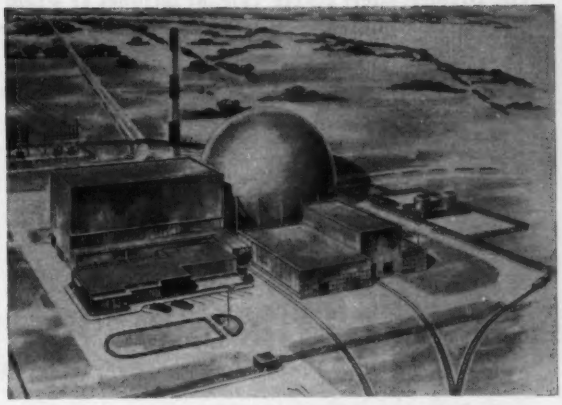

Fig. 1. Artist's conception of Dresden Nuclear Power Station.

Fig. 2. Site at start of construction.

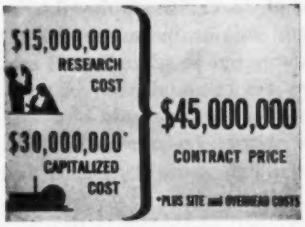

Fig. 3. Contract cost.

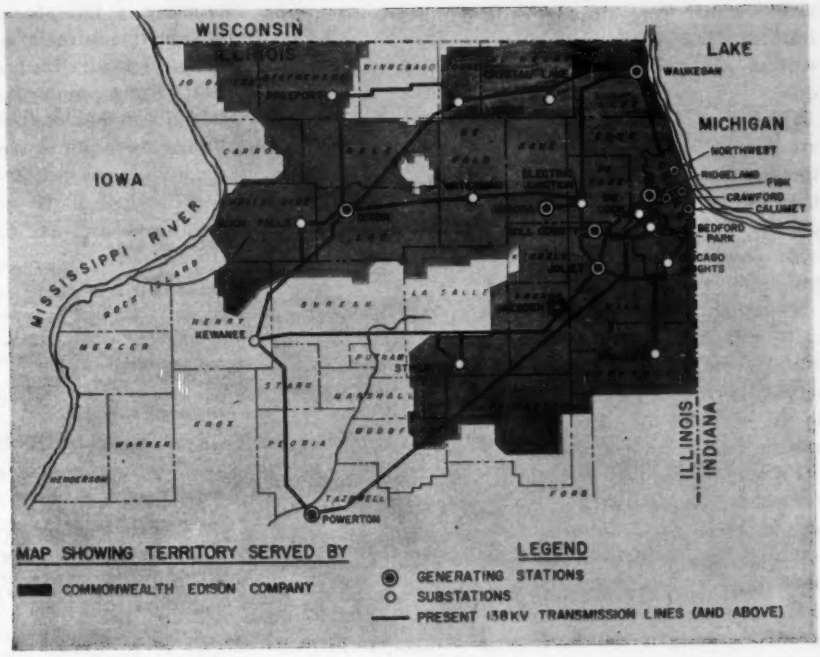

Fig. 4. Territory served by Commonwealth Edison Company.

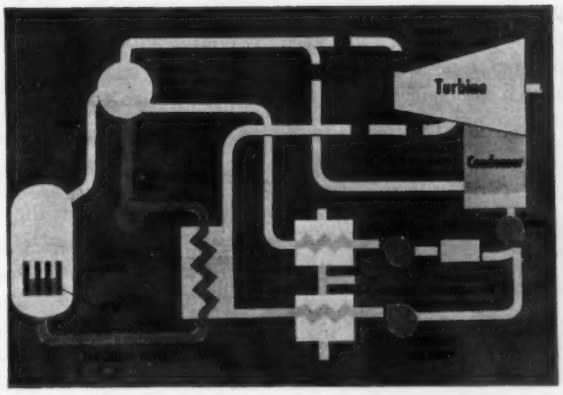

Fig. 5. Boiling-water dual-cycle flow diagram.

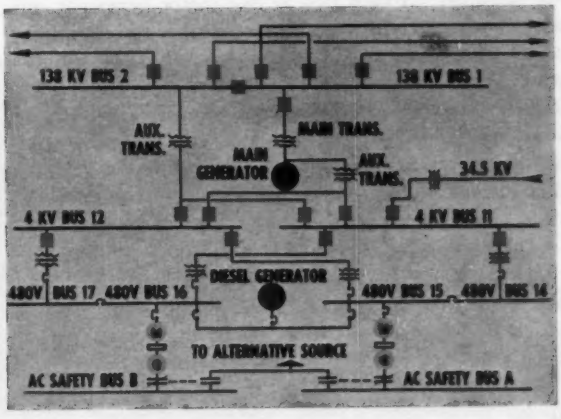

Fig. 6. Electrical one-line diagram.

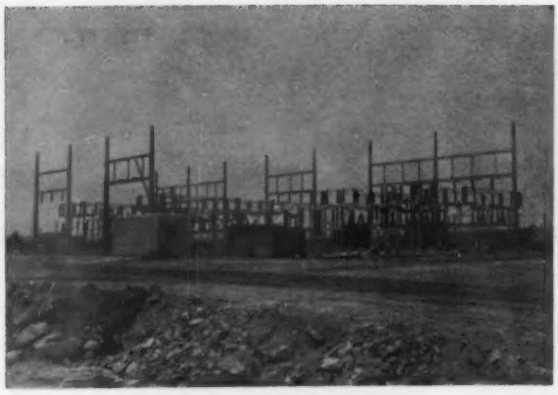

Fig. 7. Construction view of switchyard.

stores power to all equipment except the "nonessentials," which were automatically tripped prior to the transfer. The 138-kv/4,160-volt auxiliary transformer will be the source of power when the reactor is shut down.

The third source of auxiliary power, if these systems are not available, is a 2,500-kva substation connected to the 34.5-kv Commonwealth Edison distribution system which, at present, is the source of construction power. This transformer automatically provides auxilary power in case of complete loss of the other two power sources.

Fourth is a 500-kw diesel generator which automatically will start upon failure of the main sources of auxiliary power and will furnish the necessary 480-volt service needed for plant protection after a scram or in the event of complete isolation from the Commonwealth Edison system.

Fifth is a 125-volt battery which furnishes power for control of equipment and for emergency lighting as well as service for closing the d-c motor operated sphere isolation backup valves, and certain shutdown instrumentation.

Supplementing these five electric power sources to assure the integrity of the electric systems, normal instrument power supply for the reactor scram circuits are supplied through two a-c/a-c motor generator sets with flywheels to provide high reliability for continuity of plant operation. The damping effect of the flywheel inertia on minor voltage dips or surges is intended to avoid nuisance scrams from faults in the auxiliary electric system which are cleared by normal relaying. A period of about 5 seconds is provided for auxiliary power restoration before scramming the reactor.

SAFETY SYSTEM

ANOTHER BIG DIFFERENCE between a nuclear power plant and a conventional plant is the safety system which is designed to assure system shutdown (scram) upon encroachment of unsafe conditions but still provides a plant whose continued operation can be relied upon.

The Dresden safety system (Fig. 8) includes 11 scram sensory circuits and are as follows:

1. High sphere pressure
2. Low water level in the reactor vessel
3. Simultaneous, fast closure of turbine stop and bypass valves
4. Primary steam sphere isolation valves
5. Low water level in the primary drum
6. Low condenser vacuum
7. High reactor pressure
8. High water level in the scram dump tank
9. High neutron flux
10. Short period
11. Loss of auxiliary a-c power.

Thus, with the highest practical degrees of safety being the principal requirement of system design and the additional requirement of continuous plant performance, a fail-safe type of system is employed. To provide the fail-safe system, two or more contacts of independent devices are connected in series for all critical sensing points. If any device should fail in service and remain closed, the other contact would be available to open for a scram signal. To provide a high

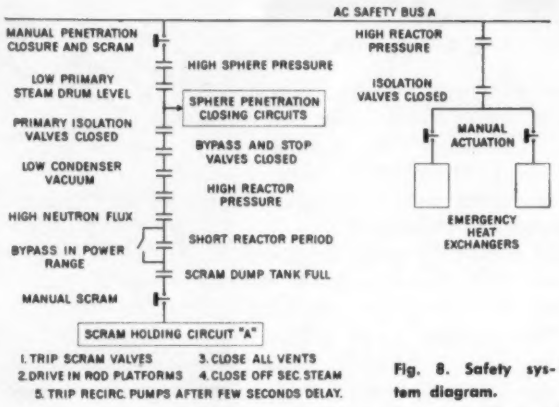

Fig. 8. Safety system diagram.

degree of freedom from nuisance scrams when one of the two devices open on failure, two parallel safety systems are utilized. The design is such that a sensing point in each system must operate before a reactor scram will result. This gives the equivalent of a series–parallel type of system, where the series feature gives a high safety factor and the parallel feature gives high operational reliability.

MASTER SELECTOR SWITCH

IN A CONVENTIONAL fossil-fueled plant, when the boiler plant is shut down all instrumentation can be taken out of service. With a nuclear plant, this cannot be done. Thus, there is another difference between the two types of plants. When the reactor is shut down, the fuel in the reactor vessel is available for power generation at all times by merely withdrawing control rods. Thus, certain instrumentation supervising the

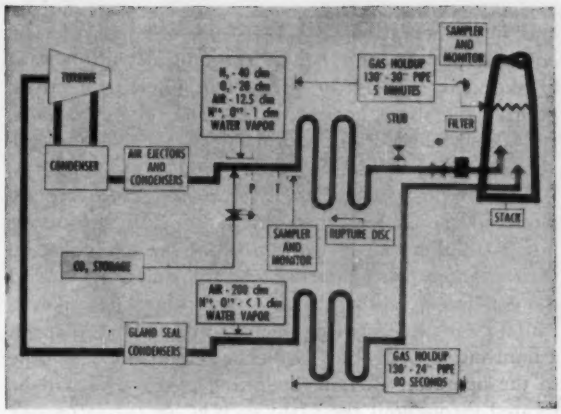

Fig. 9. Off-gas system.

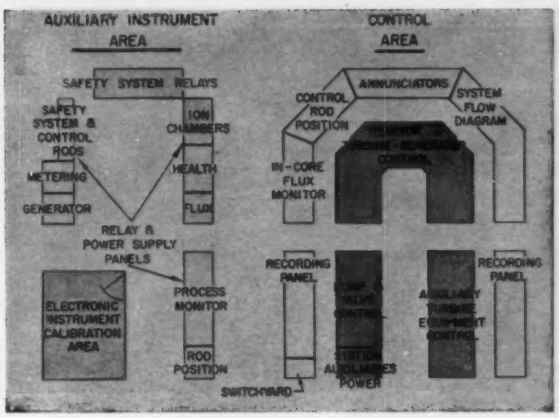

Fig. 10. Control room.

plant must remain in service during shutdown, refueling, start-up, and normal operation. To insure that the certain sensing points are provided for proper interlocking while permitting bypassing of various safety signals during modes of plant operation and maintenance when such safety signals are not valid, a master selector switch is provided. This switch is located on the operating console in the control room and has the following four positions:

1. Shutdown
2. Refueling
3. Start
4. Run

When this switch is in the "shutdown" position, both scram circuits are open, but the "high sphere pressure" and "low water level in the reactor vessel" scram circuits are transferred to a separate power source to provide sphere penetration closure protection. This provides for normal sphere ventilation during shutdown, when the control rods are held in the full-in position, and for maintenance and testing of equipment related to the safety system to be performed. No control rods can be withdrawn when the switch is in this position.

In the "refueling" position, the safety circuits are energized and the "primary steam sphere isolation valves closed," "turbine stop and bypass valves closed," "low condenser vacuum," and "low water level in primary drum" scram circuits are bypassed, but the bypass will automatically open at a reactor pressure of 200 psi so that the reactor cannot be operated at appreciable pressure with the master selector switch in this position.

In the "start" position, all scram circuits are in service, with the low-condenser-vacuum circuit partially bypassed to permit start-up with the condenser at 10 inches of vacuum; however, the reactor will scram if the primary steam pressure exceeds 200 psig and the vacuum in the condenser is not greater than 23 inches of mercury.

When the master selector switch is in the "run" position, only the short-period scram signal is bypassed

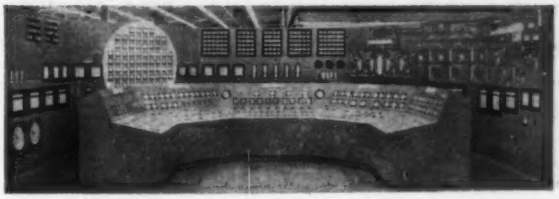

Fig. 11. Control board mock-up panels.

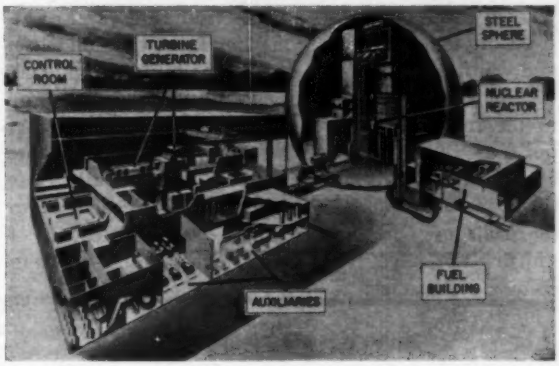

Fig. 12. Artist's cross section of turbine building, containment vessel, and fuel building.

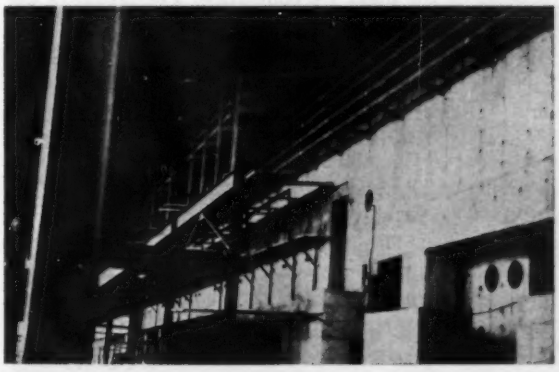

Fig. 13. Cable tray systems (construction).

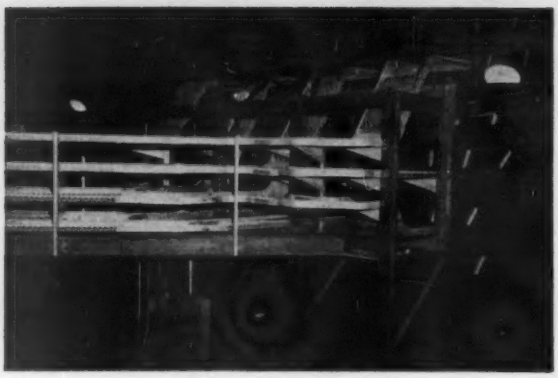

Fig. 14. Penetrations into containment vessels for cables.

as the period becomes infinite with a fixed control-rod position.

MONITORING INSTRUMENTATION

ANOTHER SAFETY ASPECT not necessary in fossil fuel plants is radiation monitoring equipment, which is located strategically throughout the plant to determine the presence of radioactivity. This equipment (Fig. 9) includes points in the main condenser air ejector exhaust piping to determine the presence of fission products, in the 300-foot stack to determine the level of activity in the mixture of off-gases from the condenser and ventilating airs from the turbine building and containment vessel in the various condensate systems, and in the reactor enclosure, turbine building, and other buildings of the plant. These monitoring units actuate alarms and, in certain instances, automatically close valves to isolate and prevent the release of activity to the environs. One, in particular, with this feature of shutting the valves is the unit which samples the gases going up the stack.

CONTROL ROOM

THE CENTRAL LOCATION of all these alarms is in the control room, the nerve center of the plant where all the various principal plant systems and equipment throughout the plant are controlled. The layout of the control room is shown in Fig. 10.

The U-shaped section of the vertical and console type control boards in the control area contains all the controls, indicators, and recorders needed by the operator to start up, operate, and shut down the reactor in a safe and systematic operating manner. The reactor, turbine, and generator are completely remote controlled at the curved portion of the U layout of the consoles (Fig. 11). The vertical panels behind these consoles contain the in-core flux-monitoring instrumentation, control rod position indicators, turbine, nuclear, and radiation annunciation, and a miniature bus arrangement of the system flow diagram.

The straight sections of the bench boards and vertical boards in this area will contain control switches and instrumentation to operate the auxiliary electric equipment and the 138-kv switchyard oil circuit breakers, as well as the many motor-operated valves, pumps, the diesel generator, exciters, demineralizers, and other mechanical equipment familiar to a conventional power station.

The auxiliary instrument area panels which are adjacent to the control area contain controls, indicators, power supplies, protective devices for the safety system, various monitoring systems, control rod systems, and the generator, plus the station metering. These panels contain instrumentation which must be referred to on a nonroutine basis, but should be reasonably accessible to the operator. Remote operating panels also will be located throughout the plant such as for the secondary heat exchangers, demineralizers, and the turbine and will contain instrumentation for transmitting system operational information to the control room. With the centralized control of the Dresden Nuclear Power Station (Fig. 12), three men will operate the plant from the control room and three other equipment attendants will be dispatched to particular parts of the station to perform various functions at remote operating panels and valve racks, and perform routine equipment inspections. No operators will be stationed at these remote panels. The control room is shielded from all plant equipment and operators can stay in this room to continue control functions in the event of difficulty in any inaccessible part of the plant system.

CABLE PENETRATIONS

WITH THE CENTRALIZED OPERATING ARRANGEMENT, an astoundingly large number of power and control cables are needed to operate the auxiliary equipment throughout the plant. These cables are routed mainly in a system of expanded metal cable trays (Fig. 13) and from the trays in conduit to the equipment. The use of cable trays is not too different from normal power plant construction, but the seal around the cables passing through the containment vessel penetrations (Fig. 14)

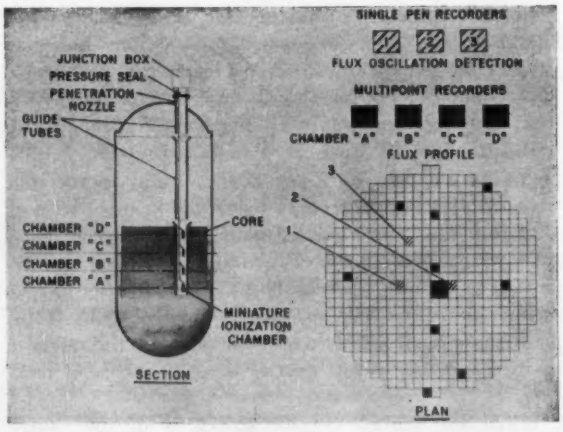

Fig. 15. Cross section of reactor vessel, showing in-core ion chambers.

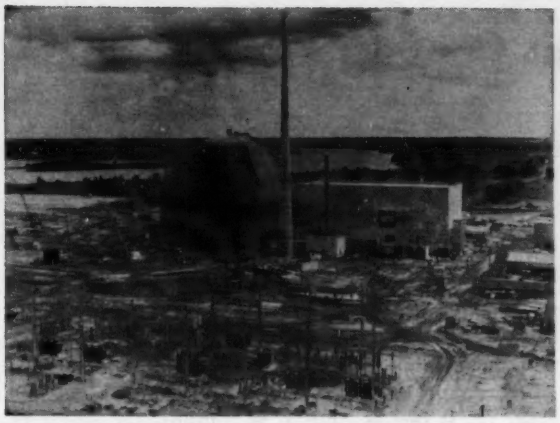

Fig. 16. Aerial view of Dresden station looking southeast (August 1, 1958).

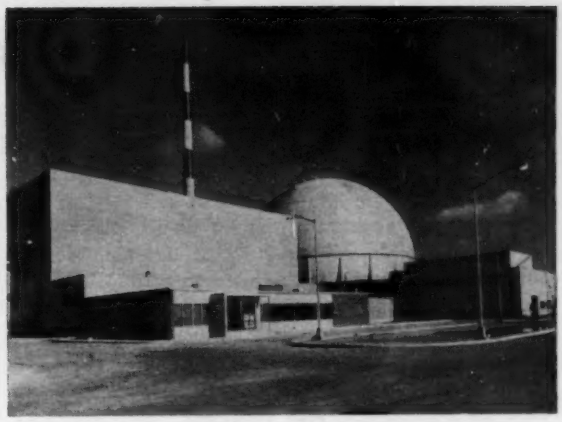

Fig. 17. Front view of Dresden station looking north (December 15, 1958).

to the equipment inside will be a matter of concern. Since the containment vessel (sphere) is designed for 29.5 psig, these cable penetration seals will need to withstand a minimum pressure of 37 psig, the requirement under Section VIII of the ASME (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code.

The General Electric Company is making extensive tests to develop the seal with conventional electrical sealing compounds such as Chico, epoxy, and No-Void.

Another type of seal that General Electric has under development is the kind which will be required in the head of the reactor vessel to withstand its design and hydrostatic test pressures of 1,250 psig and 1,875 psig, respectively. This seal is for triaxial cable going into the reactor vessel to the 64 in-core ion chambers. A typical arrangement of the ion chambers is shown in Fig. 15.

PROJECT STATUS

ENGINEERING AND DEVELOPMENT programs are substantially complete with the over-all design both by General Electric and Bechtel Corporation being about 98% complete.

Construction work, which is being done by Bechtel for General Electric, is on schedule, with the building and concrete work substantially complete and the mechanical and electric equipment and material being installed at near peak rate.

Preliminary site work was begun November 28, 1956. Target completion date for construction is late 1959 followed immediately by reactor loading, critical testing, and initial operation. The plant is scheduled for regular operation in 1960. Fig. 16 (looking southeast) and Fig. 17 (looking north) reflect construction progress as of August 1 and December 15, 1958.

Milan Reactor Building

The construction of facilities for housing a 50,000-watt atomic research reactor is nearing completion at the Enrico Fermi Nuclear Study Center, located in Milan, Italy. The solution-type reactor, which has been designed and is being built by Atomics International, a division of North American Aviation, Inc., will be used for research in the fields of physics, chemistry, and engineering. It will be installed in the large section of the building at the left. Laboratories will be located in the 2-story section at the right. The reactor is scheduled to begin operating during the summer of 1959. Atomics International also has designed and built similar research reactors which are currently operating in Japan, Denmark, Frankfurt, West Berlin, and the United States.

SAGE Data System Considerations

R. G. ENTICKNAP

E. F. SCHUSTER

A SYSTEM for transmission of binary digital data over telephone circuits has been developed for the SAGE system of air defense. This data transmission system had to meet stringent and varied requirements for data rate, error rate, general applicability, cost, and reliability in the face of enemy action.

The basic concept of this system involved automatic radar data reduction and processing and automatic computation and transmission of weapon control instructions. Efficiency dictated that a single computer center process the data from a large number of radars and provide control information to a large number of weapons bases (Fig. 1). The data communication system for interlinking these data sources and receiving locations to the computer center and between adjacent computer centers required development of new techniques and establishment of a new class of leased transmission facility.

Early work was concentrated on a small-scale system prototype known as the Cape Cod system. A number of small radars were equipped with a data reduction system known as Slowed Down Video (SDV) and transmitted data in real time to the computer via conventional voice circuits. Enlargement of the experimental system to include longer-range radars and additional types of voice telephone facilities led to the development of a new data reduction system called Fine Grain Data (FGD) for the larger radars and an improved data transmission system.

When the U. S. Air Force decided to install SAGE on a nation-wide basis, it became necessary to specify a data transmission system that would enable manufacturers to design input and output devices and commercial communication companies to provide suitable facilities. The outstanding requirements for the system were (1) There should be a "standard" system used throughout SAGE; (2) It should employ, as transmission media, facilities readily available throughout the United States; (3) Errors introduced by the data transmission should be a minimum consistent with foregoing requirement (2); and (4) Transmission rate should be as high as possible consistent with requirements (2) and (3).

A specification for a "data circuit" was established which described the character of the signal to be transmitted and prescribed data rates (1,300 and 1,600 bits per second) and error rates (1 in 10^5 bits) such that specially treated voice transmission facilities could be used.

Continuing experience led to another significant decision. The commercial communication companies agreed to provide a leased digital data service which included the terminal apparatus called digital data transmitters and digital data receivers. Specifications for input and output signals were established which provided flexibility in the location of the terminal equipment with respect to the processing machinery.

An exception to the use of data circuits occurs at combined sites where the distance between computers is relatively short. Here, the direction center computer transmits the sync, timing, and data separately over house cables to the combat center computer.

Operational requirements specify that most data circuits have a rapid restoration time in case of failure from natural causes or acts of war. Thus data circuits, furnished on separate routes which avoid major target areas, are provided.

The current frequency division ground-to-air data link system is to be replaced by a time division system. This new system requires time delay equalization such that a 2-millisecond differential limit may be met for all of its data circuits.

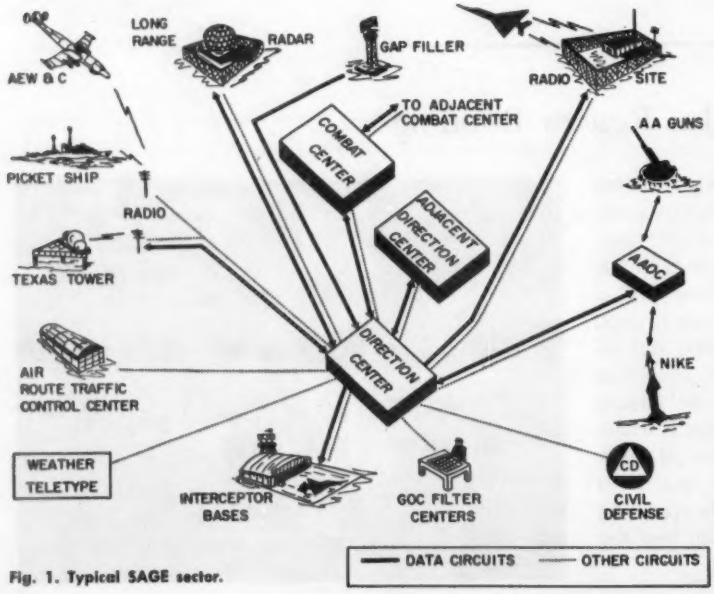

Fig. 1. Typical SAGE sector.

Digest of paper 58-302, recommended by the AIEE Data Communication Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Fall General Meeting, Pittsburgh, Pa., Oct. 26-31, 1958. Published in AIEE *Communication and Electronics*, Jan. 1959, pp. 824-32.

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The Controlled Rectifier

J. D. HARNDEN, JR.
ASSOCIATE MEMBER AIEE

NEW semiconductor devices are being developed constantly. The controlled rectifier is one of the most exciting of these new devices. This device was commercially introduced by the General Electric Company early in 1958 and has been in production ever since. Inasmuch as the controlled rectifier is capable of performing many of the functions of magnetic amplifiers and thyratrons, it represents another tool with which the engineer should be acquainted.

The controlled rectifier is a silicon device utilizing some of the properties of transistors and rectifiers to produce a new control component somewhat analogous to the thyratron. Using the gate method of triggering, the controlled rectifier has a minimum power gain in excess of 150,000 with switching times of the order of 1 microsecond. This power gain assumes continuous gate drive. For pulse methods of triggering, the power gain should be re-evaluated depending on the pulse width. Like the thyratron, the device possesses a deionization time which, however, is faster, being about three times the turn-on time.

When the rectifier is turned on, the forward drop is about 1 volt or approximately 20% greater than the equivalent voltage drop for an ordinary rectifier. This means, in order to dissipate the same amount of power from a given package, a somewhat lower current value will be necessary. The allowable current depends on the size of the unit, that is the junction area, the method and effectiveness of cooling, and the per cent on-time of the current wave form. Like any power semiconductor device, the time constant of the junction is of importance during transient conditions, while the thermal heat sink must take care of steady-state losses. The time constant of the junction is less than a half cycle of 60 cycles so that transient protection must be treated with respect. It is also possible to parallel and also connect units in series, as well as use them in multiphase connections to improve the over-all rating of the system and allow meeting many application requirements.

Fig. 1 compares a saturable reactor and a thryatron of comparable rating with the *ZJ-39A*. Not only is the controlled rectifier far smaller and lighter, but also possesses the other characteristics which have been briefly outlined before. Of course, the comparison with a self-saturating magnetic amplifier of equal rating would need to involve a rectifier complement which indicates that the controlled rectifier basically replaces not only the saturable reactor in the magnetic amplifier, but also in itself can act as the rectifier which would normally be used in such an application.

In contrast to most conventional magnetic amplifier circuits which produce full output in the absence of signal, the controlled rectifier is a fail-safe device. That is to say the output is zero in the absence of a signal. The on-to-off ratio of the controlled rectifier is exceedingly high. The average minimum holding current is approximately 10 milliamperes with peak load currents reaching 30 amperes or more. The minimum holding current is analogous to the conduction voltage drop in the thyratron since, if the current falls below this value, the controlled rectifier will revert to the open condition. In the open condition, the leakage currents in both the forward and reverse directions will be approximately the same as those found in a silicon power rectifier of comparable rating. Also note that this as well as other parameters will vary with temperature as does a silicon rectifier. Unlike the magnetic amplifier, exciting current is required to flow prior to the actual beginning of conduction. Full control is retained until the actual time of triggering. However, there is a finite leakage current which flows in both directions which might be considered somewhat analogous. The amount of leakage depends on the quality of the unit, temperature, etc.

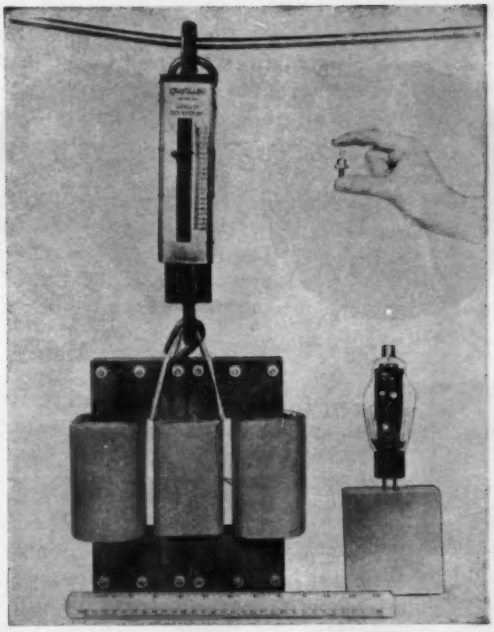

Fig. 1. Amplistat reactor, thyratron, and *ZJ-39A* controlled rectifier of approximately equal power rating.

Digest of paper 58-1234, "The Controlled Rectifier—Key to the Continuing Control Renaissance," recommended by the AIEE Semiconductor Metallic Rectifiers Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Fall General Meeting, Pittsburgh, Pa., Oct. 26-31, 1958. Published in AIEE *Transactions*, vol. 77, 1958 (January 1959 section).

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Mervin J. Kelly

1959 John Fritz Medalist

". . . his achievements in electronics, leadership of a great industrial research laboratory, and contributions to the defense of the country through science and technology."

History of the Medal

THE JOHN FRITZ MEDAL is awarded annually by a board composed of four representatives of each of the four national engineering societies—the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining, Metallurgical and Petroleum Engineers, and the American Society of Civil Engineers—for notable scientific or industrial achievements, regardless of nationality or sex and in any field of pure or applied science.

It was established by professional associates and friends of John Fritz on August 21, 1902, his 80th birthday, to perpetuate the memory of his achievements in industrial progress.

The first award of the medal was made to John Fritz at a dinner party honoring him on his 80th birthday, August 21, 1902.

The 1959 John Fritz Medal Award is being presented to Mervin J. Kelly for ". . . his achievements in electronics, leadership of a great industrial research laboratory, and contributions to the defense of the country through science and technology."

Career of the Medalist

L. K. SILLCOX
FELLOW AIEE

STRICTLY SPEAKING in the American tradition has been the rise of Mervin J. Kelly from a school principal's son to the chairmanship of the board of the world-famous Bell Telephone Laboratories. The secret of his career resides in his inventive genius, perseverance, and keen foresight. Recognized for his character and ability, and honored by his contemporaries throughout his eventful career, few men, if any, have contributed more to the progress of the world than has Mervin J. Kelly, and fewer still have lived to see such full fruition of their ideas and endeavor. He is one of the group of great electrical engineers. Such men as he come into the world but rarely. Their composition requires the happy combination of many qualities: energy, courage, vision, the ability to seize upon essentials, the inventive spark, and the power of influencing the minds of other men. This country has been fortunate in the production of a few such geniuses, scientists, and engineers, who have been at the root and basis of limitless changes.

Mervin J. Kelly was born February 14, 1894, at Princeton, Mo., to a Welsh mother and an Irish father. His father was principal of the high school at the Mercer County seat at the time of his son's birth, but shortly thereafter engaged as a hardware and farm implement merchant at Gallatin, Mo., and it was here that Mervin J. Kelly acquired his grade and high school education, graduating as class valedictorian at the age of 15. From the age of 10 until he entered the Missouri School of Mines and Metallurgy at 16, he worked at everything he could find to do in order to acquire sufficient funds to attain his ambition of becoming a mining engineer. His heart was set on a career that would take him to far places through the influence of a mining engineer returned from British Columbia, Canada. He worked hard at his studies, being very proficient in chemistry and physics. His first summer job was with the Missouri Geological Survey and the next one was spent with a Utah copper mining concern. At the end of his sophomore year, he was appointed a student assistant which gave him his tuition and enabled him to use all his spare time tutoring students. After graduating with honors and a Bachelor of Science degree, he

Full text of presentation and acceptance addresses made at the ceremony awarding the John Fritz Medal during the AIEE Winter General Meeting, New York, N. Y.. Feb. 2-6, 1959.

L. K. Sillcox is honorary vice-chairman of the New York Air Brake Company, Watertown, N. Y.

taught physics and studied mathematics at the University of Kentucky, receiving his Master's degree in 1915. On November 11, 1915, he was married to Katharine Milsted a Rolla, Mo., girl. They have a daughter and a son and four grandchildren. The young couple went to the University of Chicago where Mervin earned his Ph. D. in physics in 1918 and, at the same time, was assistant to Prof. R. A. Millikan, participating in the famous oil drop experiments for measuring the charge of the electron.

At the instance of F. B. Jewett, the young physicist, Dr. M. J. Kelly, took a $2,100 a year job in the research laboratory of the Western Electric Company and plunged into the problem of bringing the electronic vacuum tube out of the laboratory into production for military and commercial use.

The next 10 years comprise the period of Mervin Kelly's individual participation in laboratory work. Telephony was growing up from a local to a nationwide and then a world-wide service. The key to this change was the electronic vacuum tube. In this service, great stability and reliability were essential. Dr. Kelly's research group brought the life of telephone repeater tubes from 1,000 hours up to the phenomenal figure of 80,000 hours. In transoceanic radio telephony very high frequency and great power were required. Kelly and his associates developed water-cooled tubes which were the grandfathers of all the powerful water-cooled tubes now serving in the broadcasting and television stations of the land. He soon found himself not only heading a research and development program but operating an electron tube factory as well.

In 1925, the research and development work of Western Electric was incorporated separately as Bell Telephone Laboratories. In 1934, the related work of the parent company, American Telephone & Telegraph Company was amalgamated into Bell Laboratories which became the center of the Bell System's forward-looking technical responsibility. It became evident to those in authority that M. J. Kelly was a young man of great potential value to the institution and he was started on a rotation of assignment which gave him responsibility for research and development in a variety of fields.

Beginning in 1928, his area of technical interest broadened to include applications of acoustics in telephony. In 1934, he was made development director of transmission instruments and electronics for Bell Telephone Laboratories and, in 1936, was appointed director of research.

When World War II broke out, Kelly was given a centralized responsibility for Bell Laboratories war research and development comprising radar, gunfire control, and bombsight activities and including all but a few specialties in the vast array of military projects carried out by the organization. The $175 million laboratory program produced electronic and communications designs from which over $2 billion worth of equipment was manufactured.

Near the close of the war (1944), Dr. Kelly became executive vice-president of the Laboratories, and in 1951 its president. It is during this last 14-year period, up to the present time, that his greatest services have been rendered to industrial research, to education, and to the military and moral strength of the United States.

Under Dr. Kelly's leadership, Bell Telephone Laboratories has expanded to handle its enlarged load of work until it now employs about 11,000 persons of whom approximately one third are trained scientists and engineers. Basic research has been strengthened and the procedures of development have been rearranged. Changes in organizational structure have brought forward young executive talent. The high reputation which this Laboratory has long enjoyed has been maintained and enhanced by the intelligence, foresight, and drive used by Dr. Kelly in directing it.

In the field of education Dr. Kelly's most direct achievement is the establishment of a 3-year graduate

MERVIN J. KELLY, seated left, receiving the John Fritz Medal Award from J. C. Montieth as L. K. Silcox (*left, standing*) and L. F. Reinartz, who gave the History of the Medal speech, look on.

level in-hour training course for the 100 or more young engineers who come each year into Bell Laboratories work. He saw clearly the need for increasing the fundamental training of development personnel to match the trend, in which he has also led, toward a greater proportion of Ph. D.'s in research work. He has persistently proclaimed this doctrine in speeches and articles, and has urged that the universities not only train more engineers but carry their training to higher levels.

In the academic field Kelly has many activities. He

is a Life Member of the Massachusetts Institute of Technology (MIT) Corporation and a Member of its executive committee, and a trustee of Stevens Institute of Technology, and has served on advisory committees at MIT, Princeton, New York University, Case Institute of Technology, Columbia University, and the N.Y. City Board of Education.

Since World War II, Dr. Kelly has had many important assignments of a public service nature. He was vice-chairman of the U.S. Air Force's Scientific Advisory Board from 1950 through 1954 and chairman in 1955. He also served as advisor to Secretary Finletter of the Air Force on the organization and expansion of its research development work. In 1957, he accepted an invitation to serve for a 3-year term as a member of the board of visitors to the Air University at Montgomery, Ala.

The Air Force Association awarded Dr. Kelly its 1953 Trophy ". . . for distinguished service to air power in the field of science." He also holds the Air Force Exceptional Service Award, presented by Secretary of the Air Force Douglas in July 1957.

In addition, Dr. Kelly has been a member of the Naval Research Advisory Committee since 1954 and served as vice-chairman in 1956.

He has advised the Atomic Energy Commission (AEC) on its military research and development programs. In 1953, he was chairman of a committee for the Secretary of Defense to study the problems of continental defense against atomic attack and to make recommendations on organization and programs. Early in 1954, he was named a member of the Hoover Commission Committee on Business Organization of the Department of Defense and was chairman of its Subcommittee on Research Activities in the Department of Defense and Defense Related Agencies. He is a member-at-large of the Defense Science Board which was established as a result of the recomendations of this Hoover Commission Subcommittee.

Dr. Kelly is chairman of a National Academy of Sciences committee formed at the request of the Secretary of Commerce to survey the research and development activities of the Department of Commerce.

In 1952, he served as chairman of the National Academy of Sciences' ad hoc Advisory Committee to the Secretary of Commerce on the appointment of a permanent director of the National Bureau of Standards. In 1953, he headed a committee for the Secretary of Commerce to study the effectiveness of the Bureau of Standards and to make recommendations concerning its organization and programs. Since 1952, he has been a member of the Bureau of Standards' Statuatory Visiting Committee, and has served as chairman since 1954.

One of Dr. Kelly's most recent achievements in the interests of the engineering profession has been his chairmanship of the industry campaign to fund the new $10 million United Engineering Center, the national headquarters for engineering societies whose membership totals over a quarter of a million engineers.

Dr. Kelly is a Fellow of the American Physical Society, the Acoustical Society of America, the Institute of Radio Engineers; a member of the National Academy of Sciences, the American Philosophical Society, a Foreign Member of the Swedish Royal Academy of Sciences, and a member of the honor scientific and engineering societies Sigma Xi, Tau Beta Pi, and Eta Kappa Nu.

He holds honorary Doctor of Engineering degrees from his alma mater (1936), New York University (1955), Polytechnic Institute of Brooklyn (1955), and Wayne State University (1958); honorary Doctor of Science degrees from the University of Kentucky (1946) and the University of Pittsburgh (1957); and an honorary Doctor of Laws degree conferred by the University of Pennsylvania (1954). In November 1957, he was awarded an honorary Doctor's degree by the University of Lyon.

Dr. Kelly has served on the board of directors of Bell Telephone Laboratories since 1944. He is a director of the Prudential Insurance Company of America, Bausch & Lomb Optical Company, Tung-Sol Electric, Inc., and a director of the Economic Club of New York.

He is also a trustee of the Alfred P. Sloan Foundation, a trustee and a member of the corporation of Atoms-for-Peace Awards, and a member of the New York City Health Research Council.

Despite a work schedule that would wind a less rugged man, he still finds time for his favorite hobby—flower gardening. At his home, Windemere Terrace, Short Hills, N.J., he has an acre and a half garden planned so that he has flowers blooming from March to December. He has a bulb garden of some 30,000 tulips, hyacinths, daffodils, and narcissus. He grows everything from zinnias, marigolds, and asters to almost every known chrysanthemum.

In April 1954, Dr. Kelley was awarded the 1954 medal of the Industrial Research Institute for his ". . . distinguished leadership in industrial research, joining the mind of the scientist and the hand of the technologist to serve the security and well-being of mankind, and for outstanding personal contributions to national security." In October 1955, he was awarded the Christopher Columbus International Communication Prize. On January 29th, 1959, at the Sheraton-Park Hotel, Washington, D. C., Dr. Kelly joined President Eisenhower, David Sarnoff, General Alfred M. Gruenther, and Admiral Arthur W. Radford who were similarly honored in past years for their accomplishments in furthering American defense and received the James Forrestal Memorial Award.

To his friends he is ever, without break, an entirely delightful being. For his utter devotion to his tasks, for his unending generosity to the causes of our day, it is hard to find a better word than matchless. Yet his is a matchlessness that comes from the spirit of the man, that is only equalled by his rugged directness that cannot be other than warm and true. No wonder he is admired for his quality of the "expert guess" and for his warmth of friendship.

Development of the Nation's Scientific and Technical Potential

M. J. KELLY
FELLOW AIEE

I RECEIVE the 1959 John Fritz Medal with pride and humility. To be enrolled among the illustrious recipients of this medal, extending across the last half century, is a sobering honor. It is a superlative climax to my 41-year career of service to science and technology as a member of the Bell System, that comes to its close at the end of this month with my retirement from Bell System service upon reaching my 65th birthday.

I take the opportunity that this award ceremony provides for presenting to so large a group of the nation's engineers a most challenging and vitally important problem of our society. It is an oft-discussed problem. but because of its importance it cannot be reviewed too frequently. It is central to the survival and continuance of our democratic way of life with the dignity and freedoms for the individual that it insures.

The problem—The full development of the scientific and technical potential of our people. Although the Nation's accomplishments in science and technology of the past half century and particularly of the immediately past two decades have been impressive, we have failed by a wide margin to develop to the full our society's scientific and technical potential. Unless we do this, the nation could well lose its world leadership and its present democratic, social, and political structure which provide a dignity, freedom, and service for the individual unequaled by any other form of society.

During the past four decades, a so-called communist society has been developing in the USSR, the avowed purpose of which is the imposition of its form of social structure on all peoples of the world. In this system, the dignity and freedom of the individual are completely subordinated to the interest and will of the state, as determined by a few in positions of absolute authority, who are maintained by police force.

A small, but of excellent quality, educational system of the Russian monarchy that the revolutionaries overthrew has served as a foundation on which has been erected in the past 40 years a mammoth educational system patterned and dedicated to the full development of the scientific and technical potential of the people of the Soviet States. This educational system has been the central instrument in the ruthless drive toward their goal. With rare vision of its essentiality for their avowed purpose, they have given scientific and technologic education large financial support and have provided a most favorable environment for the development of a very large and competent corps of scientists and engineers.

An authoritarian state, such as that of the Soviet, is endowed with three most effective capacities: prompt decision, rapid movement from decision to action, and concentration of great power in implementing the action. The Soviets have utilized these capacities in building, in less than one generation, an educational system of the highest quality and most effective for their avowed purpose. This educational system has served as the foundation on which they have built a scientific and technical strength second only to ours.

The planned educational program of the system is universal. It applies to all of their children, beginning with their entrance into the secondary schools. It is rigorous, exacting, and thorough, demanding studious attention to mathematics, science, languages, and communist political philosophy. Quite aside from the early and rigorous exposure that it gives to the areas of learning deemed essential to their avowed goal, it develops studious work habits, maturity, and purpose at an early age.

Upon completion of secondary schooling at the age of 17 or 18, rigorous examinations determine those of the quality to continue studies in institutions roughly the equivalent of our universities and technical schools. Those of inadequate quality usually enter the Technicums, or their equivalent, where they are trained as skilled artisans and technicians for industry, agriculture, and the large number of scientific and technical institutes that carry out vast programs of basic and applied research and development. The sorting out of the gifted from those less well endowed that is done by these entrance examinations determines, with minor exceptions, whether one may have a professional career or must have that of an artisan or technician.

Those entering the universities and technical institutes have received a depth of training in science, mathematics, and languages of at least 2 years beyond that of our high school graduates and, most important, they have acquired studious habits and intellectual maturity that are not generally instilled by our secondary school system.

In the university years, the demands placed on the students are further increased. Whether they be students of science or of its applications in engineering—their mathematics, science, and languages training is basic, penetrating, and rigorous. When they complete their 4 years, they have science and mathematics training that is 2 or more years beyond that of our median E.C.P.D. engineering schools. Those selected for careers in science enter upon a graduate program in general similar to that of our young scientists in their quest for their Ph.D.'s. An increasing fraction of those destined for careers in engineering are also receiving further academic training.

To utilize these excellently trained young men and women in the state's progress toward its avowed goal, there are a very large number of institutes dedicated to research (basic and applied) and creative tech-

M. J. Kelly is chairman of the board of the Bell Telephone Laboratories, Inc., New York, N. Y.

nology. A common characteristic of all of these institutes is the excellent quality of the facilities that instrument their programs and the abundance of capable subprofessional technical aides supplied. Whether the institute be one concerned with the structure of the atom's nucleus or with the solid state of matter—and whether its programs are in pure science or in its applications—the state's support in facilities and technical aides is most generous; it borders on the lavish.

As strength has developed in science and technology in the pattern I have described, they have employed it in building industrial and military power. In industry, emphasis has been given to the production of steel, aluminum, oil, electric power, and all other capital-goods items basic to military strength. Although their present annual production of heavy industrial materials is still in the range of 30 to 50 per cent of ours, their rate of increase in production is greater. So, as a minimum, equality with our production levels seems inevitable.

Following our lead, they have based their primary military strength on applications of atomic energy, aerodynamics, and electronics. Even though they have created a huge atomic weapons war power, ours is still greater; but it is only a question of time before their primary military power will equal ours. It could well surpass ours should we lessen our vigilance and lose our determination.

As a backup to their atomic war power they have maintained and modernized much of their World War II capacity for conventional warfare. This we have done to much less an extent; the added burden for this to our economy would entail sacrifice which regretably a democratic society will not impose on itself in times of peace—even though it be a troubled peace.

In contrast, in building their industrial and military power at so fast a pace, the quality of living of the Soviet people has suffered. Until quite recently, even the bare necessities of a spartan life were in short supply. In the last few years, however, there has been an increasing allocation of effort and materials for improving living standards. Shelter, though improving through a mammoth apartment building program, is still grievously inadequate; food is in good supply and some of the conveniences and niceties of living are becoming available.

The remarkable speed and effectiveness with which the Soviets have built their educational system and scientific and technical strength owe much to their borrowing the incentive system of our capitalist economy. Educators, scientists, and engineers—and not, in contrast with us, their athletes, coaches, and entertainers of stage and screen—occupy a most favored place in the esteem of the people and in the material rewards that they receive. Along with the top communist bureaucrats and industrial managers, they receive the highest compensation. In a society where the quality of living varies over a wider range than ours, educators (at the university and graduate school levels), scientists, and engineers enjoy a quality of living at and near the pinnacle. Their application of our incentive system in rewarding those essential to education, science, and technology contributes greatly in their march toward their avowed goal.

The progress of the USSR in the rapid conversion from a feudal agricultural society into a modern industrial society is the marvel of our time. Their programs have exhibited a remarkable clarity of vision of the essential elements for this conversion of their society. Their zeal, driving energy, and hard work in developing these essential elements, in spite of a major and devastating war fought on their own soil, justify admiration even though their ruthless methods do not.

The USSR's rapidly developing strength would give us no concern were it not for their avowed and repeatedly stated purpose to eliminate from the world the capitalist competitive economic system built on a truly democratic society, and to substitute for it their form of society in which the state is supreme with the individual completely subservient to it. As long as their goal is unaltered, we have no choice but to accept the challenge and, as a people, develop to the fullest our potential strength and maintain ways of life that will insure that their goal will not be attained.

Western society must be alert on many fronts if it is to be preserved without a sacrifice of the individual's dignity and freedoms that centuries of internal struggle have won. As I stated earlier, the uniquely essential front is the full development of the scientific and technical potential of its people.

Having viewed the communists' progress over the past 40 years in the development of their potential, we will now turn to an analysis of our progress in this development and the actions that we must take if we are to realize the rewards and the security that will accrue from its full development and, of course, its effective use.

The basic element of this potential of a people is the capacity for scientific and technical accomplishment that resides in the individuals of the society. The percentage of our people endowed with the special mental and emotional qualities for contributions to science and technology is, without doubt, the equal of that of any people. I do not believe that we are either handicapped or have an advantage over the Soviets, or any other people, in the amount and quality of this latent capacity. Our challenge, therefore, is to provide educational programs, incentives, and take actions that insure our searching out and fully developing those possessing these latent capacities. Whether our democratic society continues, through the generations to come, with its freedoms for the individual and the dignity it endows him with, may well depend on the effectiveness with which it develops and utilizes this potential in comparison with the effectiveness of its development and utilization by a communist society. This is a clean-cut test of the relative effectiveness of these two forms of society, with its outcome determining the future form of world society.

The search for the specially endowed individuals

and their development must begin in the early years of education of the youth—in our secondary schools. As the specially gifted are found, their interest must be aroused and they must be challenged with a curriculum that will not only develop these capacities as rapidly as can be, but also will instill studious habits and give purpose to life and maturity in action.

I do not propose here to analyze and evaluate in detail our secondary school systems' performance in realizing these goals, but will state that its deficiencies in meeting this challenge are very great. Neither in its finding of the talented and arousing their interest, nor in the development of the talent, is our secondary school system performing the service to our society that the challenge it faces requires.

In a recent report to the trustees, the president of one of our leading technical universities said, "An undergraduate in any first class technical university usually expects the same spoon feeding system that marked his secondary education. He needs time to understand that from now on he must be his own teacher. He is far from ready to cope with a mature concept of learning."

I believe that it can be fairly stated our secondary schools are not finding a goodly percentage of our youth that are specially endowed for careers in science or technology. For those found, the depth of training in mathematics and science is much less than it should be if the mental development that is possible at the age of completion of high school training is to be realized. The method of teaching, the disciplines, the curricula, and the amount of effort they require do not give the depth of training, the maturity, the studious habits and the purpose that should be attained by a youth of 17 or 18 years of age.

May I say that the cause of these deficiencies does not reside entirely in our school system, but also in our society and in the home. The system is a product of our society, whose motivations and sense of values have played an important role in establishing the sad state of our secondary schools.

With the realization in the last few years of these secondary school deficiencies and of their importance, increasing attention to them and means for their correction are being given in many quarters. I shall mention only two such projects. Because of their uniqueness and the competence of their execution they deserve commanding attention.

Dr. James B. Conant, an eminent scientist and educator, former president of Harvard University, with enlarged vision through his contributions in World War II as a member of the Executive Group of the Office of Scientific Research and Development, and later as Ambassador to Germany, has undertaken an individual study of our secondary schools throughout the land, the large and the small, familiarizing himself through personal contact with the teachers, the students, and the curricula. His findings and recommendations, both because of the method of his study and his great competence as an educator and scientist, should have great weight in the Nation's correction of the secondary schools' inadequacies in the area of our interest today.

The most significant proposal of Dr. Conant is the recognition by all schools that the intellectual capacities of our children vary over a wide range and that students be divided into classes according to their capacities. This will permit those of greatest intellectual capacity to be challenged to the full. This will insure not only the maximum possible depth of their training but also the development of studious habits, purpose, and maturity.

The second project is located at Massachusetts Institute of Technology, supported by the national and private foundations and led by that brilliant, dynamic physicist, Dr. Jerrold R. Zacharias. It is building a high school course in physics, based on modern concepts and pitched at a challenging level. Substantially, no research physicist has concerned himself with high school physics curricula since Millikan and Gale, some 40 years ago. Many high school teachers, using their text as a pattern but submerging the physics in voluminous descriptions of its applications in technology, have written textbooks. They are generally uninspiring and inadequate as an introduction to the science of matter and energy.

The university and technical school training in science and engineering must, of course, begin at a level determined by the depth of training and the maturity of the high school student. Only a few of our nontax-supported institutions, having rigorous entrance requirements that provide a screened group of entrants, begin the training at a more advanced level. This results in most of our engineering students beginning their training at a level of from one to two years behind that of their Soviet and European counterparts.

The vast majority of our engineers receive only 4 years of training. The demands placed on them by our universities and technical schools are far less than those placed on Soviet and European students. The Soviet and European school year is longer, their hours in class each day are more, and they have fewer interrupting holidays. This, coupled with the greater maturity and depth of training that their equivalent secondary schools afford, is giving them a body of engineers with more than 2 years' advantage in maturity and depth of training in mathematics and the sciences.

Quite aside from what the Soviets are doing, the scientific depth of technology and the increased speed in converting new scientific knowledge into new technology of the past two decades, demand engineers, especially those entering development or creative technology, with deeper mathematics and science understanding than needed formerly. Yet a large majority of our young engineers, for a variety of reasons, begin their professional careers with only 4 years of training.

The depth of training of many of our engineers who enter development or creative technology is increased through part time, in- or out-of-work-hours training. It takes a variety of forms. I believe that one of the

most comprehensive is that of Bell Telephone Laboratories. Here, all 4-year engineering graduates are required to attend an in-hours and in-house graduate school for 3 years, devoting substantially half of the standard work period to the school. In recent years, New York University has conducted the first 2 years of the course and gives a master's degree to those doing satisfactory work.

However good it may be, graduate training while working is not an adequate substitute for training in an academic institution. Every effort should be made by all concerned—industry, the professional engineering societies, and the academic world—to bring an increase in the amount of time spent in the academic institutions by our young engineers destined for careers in creative technology.

Until recent years, too much of engineering training was devoted to "practice" and too little to mathematics and science. Drafting, shop work, power or chemical plant, or structure design are typical of the "practice" courses. However, in recent years the amount of "practice" in the curricula has decreased and the amount of science and mathematics increased. This trend, which in many of our engineering schools has a long way to go, should continue. Also the number of engineers continuing in academic institutions beyond the 4 years is slowly increasing. The trend should be accelerated, but residence should be in schools with faculties and facilities adequate for graduate instruction. The professional engineering societies and industry can make large contributions to curricula improvement and increased graduate training.

The training of our scientists presents a more favorable picture. Almost universally, those preparing for careers of research in science continue their training to the doctorate level, which requires 3 to 5 years beyond the bachelor's degree level. A growing fraction of our young scientists are also receiving postdoctoral training. Postdoctoral fellowships established by the Government, industry, and private foundations are making this possible. The Nation's programs of training for careers in science compares most favorably with those of the USSR and Western Europe. Ours is perhaps the best.

Our educational programs from secondary school through graduate school and our basic research carried out in academic institutions in all areas of science and mathematics are greatly handicapped by inadequate financial support. How tragic, when these activities are absolutely basic to our survival! The financial support is inadequate for housing, facilities, and compensation of faculty and pure researchers. While progress is being made in minimizing the inadequacy of financial support, it is much too slow; our sights are not nearly high enough.

The low compensation level of our faculties is fraught with serious consequences. A material reward incentive simply does not exist. We are failing to attract and to hold in teaching at all levels and in basic research in our academic institutions their needed share of the young scientists and engineers of highest quality.

With the increasing demands of industry for scientists and deeply trained engineers—and that is good—and the higher level of compensation that industry offers, industry is syphoning off from the academic world too large a percentage of the most gifted of our young scientists and engineers. The starting level of pay in industry of the top quality level of Ph. D.'s in science is frequently 50 per cent more than that of the professor under whom the young scientist did his thesis, often a man of 50 or more years of age.

Should this situation be allowed to continue, its results will be tragic. The quality of our graduate schools will suffer. The source of supply of adequately trained and inspired young scientists and engineers will wither away and the Nation's number one place in science and technology will be lost.

From this analysis it is abundantly clear that the Nation is not facing up with required vigor to the "full development of its scientific and technical potential." A democratic society is especially lacking in the first of the three capacities: prompt decision, rapid movement from decision to action, and concentration of great power in implementing the action. However, once our society has made a decision, it can move with great effectiveness to action and the concentration of the required power.

For example, after Korea, the Nation decided that the communists posed a major military threat and to counter it has spent more than $200 billion in 7 years in building and maintaining military strength. When the Nation recognizes and understands the nature of the threat of our failure to develop to the full our scientific and technical potential, I am confident that the resources, the favorable environment, and the required actions will be forthcoming.

Recognition and understanding can only come to our people through education. It is the solemn duty of each of us, who has this recognition and understanding, to work ceaselessly in spreading the area of recognition and understanding throughout the land and to aid in the actions to be taken in ways most appropriate to each of us.

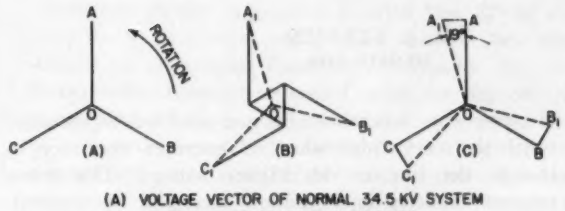
The professional engineering societies can make large contribution. In closing, I urge the societies that award the John Fritz Medal, of which I am this year's recipient, to take leadership in bringing to the people of the Nation an understanding of the vital importance of the development to the full of our scientific and technical potential.

It is, of course, equally important that our use of this potential be maximized. Our utilization of the present level of our scientific and technical potential is not good—it can be much more effective; but that is a subject for another time.

Wear Your ◆ AIEE Badge

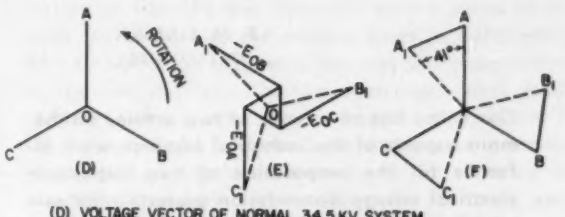
Added Angles for Melting Ice from Power Lines

I. R. EKSTROM
MEMBER AIEE



(A) VOLTAGE VECTOR OF NORMAL 34.5 KV SYSTEM
(B) NEUTRAL ENDS OF 34.5 KV WINDINGS RE-CONNECTED TO 12 KV TERTIARY
(C) PHASE DISPLACEMENT BETWEEN PHASE-SHIFTED TRANSFORMER AND NORMAL SYSTEM

Fig. 1. Development of the 19° phase shift.



(D) VOLTAGE VECTOR OF NORMAL 34.5 KV SYSTEM
(E) 34.5 KV WINDINGS RE-CONNECTED TO 12 KV TERTIARY
(F) PHASE DISPLACEMENT BETWEEN PHASE-SHIFTED TRANSFORMER AND NORMAL SYSTEM

Fig. 2. Development of the 41° phase shift.

ONE LIMITATION of previously known methods of melting ice from transmission lines has been the range of line lengths that could be so treated while in service. The 60° phase-shift method is applicable to 34.5 kv lines of only 25 to 35 miles in length depending upon design impedance and conductor size. To circumvent this limitation, methods of shifting phases 19° and 41° were developed. The range of lengths that can now be cleared of ice while in service has been increased to include lines 5 to 25 miles long.

These new phase-angle shifts are possible on 138/34.5/12-kv transformer banks or polyphase transformers. The 19° phase shift is accomplished by separating the neutral ends of the 34.5-kv windings which are normally connected in Y and reconnecting them to appropriate corners of the 12-kv closed delta tertiary as shown in Fig. 1. By this means, the low-voltage end of each phase vector is shifted about 7 kv above zero potential in a direction at right angles to the vector itself as shown in vector diagram B. Resultant voltages E_{OA_1}, E_{OB_1}, and E_{OC_1} are approximately 5 per cent higher than the normal system. Vector diagram C shows a comparison between the normal system and phase-shifted vectors, and provides the voltages E_{A_1A}, E_{B_1B}, and E_{C_1C}, which cause the flow of circulating ice-melt current in the line to which it is applied. These voltages are in the order of 7 kv, and on an equivalent 3-phase short-circuit basis become approximately 12 kv which will produce the required ice-melting amperes in a 34.5-kv line 5 to 15 miles long.

Fig. 2 shows how a 41° phase-angle shift is accomplished by again separating the neutral ends of the 34.5-kv windings, but in this case it is the high-voltage ends that are connected to the 12-kv delta. In this case, it is the voltage $-E_{OB}$ that results in voltage vector E_{OA_1}, $-E_{OC}$ results in E_{OB_1}, and $-E_{OA}$ results in E_{OC_1}. Vector diagram F is a comparison between the normal system and phase shifted voltages showing a 41° displacement which provides the new voltages E_{A_1A}, E_{B_1B} and E_{C_1C}. Here, the equivalent short-circuit voltage is approximately 25 kv, usable for melting ice from a 34.5-kv line 15 to 25 miles long.

If we assume counter-clockwise rotation, the foregoing phase-angle shifts are in the lead direction with respect to the normal system. In the event a lag angle is desired, it can be accomplished by reversing the 12-kv tertiary connections and making appropriate phase connections to the 34.5-kv windings. Where the line affected has larger conductors at its remote end than at the end where the phase shift is accomplished, it will be desirable to shift the phase angle in such lag direction. Thus, in the case where a line supplies load along its length, the greater ampere flow will occur at the end having those larger conductors. Another consideration is in cases where the line involved is one of several, each of which supplies one of several transformers feeding a primary network distribution system. The lag angle will cause the network relay to open the circuit breaker on the low voltage side of the transformer supplied by this line at the start of such melting operation and to close it when the line is restored to normal.

In the area of using the 34.5-kv phase shift for melting ice on higher voltage lines that have been taken out of service, the foregoing opens the way to a greater flexibility as to the length of lines that can be protected. By adding one more set of two-way, gang-operated disconnects to the installation, a 120° roll can be accomplished. There are then available 120° – 41°, or 79°, and 120° – 19°, or 101°, phase shifts. The 79° phase shift is also applicable to melting ice from 34.5-kv lines while in service, providing the line-terminal voltages are raised to 10 per cent above normal.

Digest of paper 58-1156, "More Angles of Phase Shift Added to Previously Known Ice Melting Methods," recommended by the AIEE System Engineering Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Fall General Meeting, Pittsburgh, Pa., Oct. 26-31, 1958. Published in AIEE *Transactions*, vol. 77, 1958 (February 1959 section).

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Research in France which Established 380/420-Kv A-C System

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This is the first of a series of two articles on the main aspects of the industrial research work in France for the preparation of two important electrical energy transmission projects—the establishment of the French 380/420 kv system, and the submarine d-c cable interconnection between Great Britain and France. The concluding article dealing with the latter project will appear in the June issue.

THE FRENCH 225-kv system came into being in 1932. Its creation was justified by the necessity of transmitting large quantities of electrical energy from the southern half of France, where the mountainous massifs have abundant hydraulic resources, and the northern half which includes, in particular, the main center of consumption constituted by the Paris area.

Less than 10 years later, it became apparent that the transmission of energy between the two halves of the country was expanding so quickly that on economic grounds it was advisable to consider the subsequent introduction of a higher voltage. After the question had been studied, the new voltage level was fixed at 380 kv. This was a sufficiently large jump to avoid the well-known drawbacks inherent in the coexistence in one and the same network of two voltage levels lying too close to each other. In addition, from a strictly economic viewpoint, this new voltage was suitable for the quantity of energy which it was reasonable to expect would have to be transmitted in the future.

In any case, the choice of this level did not imply its immediate adoption in service. The construction at that early date of a 380-kv system and its operation at that voltage would have involved serious drawbacks. The 225-kv system was as yet inadequate to bear the possible transfer of the load carried by a 380-kv line, and doubling the latter from the very beginning would have necessitated capital investments which would have remained unprofitable for many years. Moreover, technical progress was perhaps not yet sufficiently advanced to deal with the new voltage immediately. Nevertheless, it was not possible to delay increasing the transmission capacity of the system. To avoid the risk of having eventually to retain too many 225-kv circuits, recourse was had[1] to a solution which consisted in a line originally equipped with two 225-kv circuits and capable of being converted subsequently into a single 380-kv line. The initial cost of such a line is practically the same as that of two single 225-kv lines. As to the cost of conversion, it is reasonable and need not be incurred until the very time when it becomes necessary to change the line to the higher voltage. The transmission capacity is thereupon increased by approximately 70 per cent.

This was the principle on which several double convertible lines were successively constructed in France, in particular one line 405 kilometers (km) (252 miles) long between the Massif Central and Paris put into service at the end of 1946, and one line 555 km (345 miles) long between the Alps and Paris put into service in 1953. They were equipped with 6 steel reinforced aluminum cable (ACSR) conductors with a total cross-sectional area of 411 square millimeters (mm^2) (810 thousand circular mills [MCM]) and an outside diameter of 26.4 millimeters (mm) (1.04 inches).

In addition to the advantages already mentioned, this solution had the merit of fixing, at least approximately, the value of the future voltage level at the time of construction of the first line; for in fact, the maximum value of the operating voltage of a line is conditional upon the size of the towers once they have been constructed. Thus, advantage could be taken of the time which would elapse between the construction of the first line and the first putting into operation at the higher voltage to work out the solution of the numerous technical problems raised by the use of such a high voltage with full knowledge of all the points involved.

As a matter of fact, the first converted line (Génissiat–Paris) was put into service at 380-kv in March 1958 some twelve years after the construction of the first convertible line (Massif Central–Paris). Thanks to this lengthy lapse of time it was possible to carry out all the studies and research necessary to define the characteristics of the various installations with a view to ensuring the greatest possible safety and reliability in the operation of the new system.

The main problem to be solved was that of the choice of the line conductors on which the value of the new voltage level, provisionally fixed at approximately 400 kv, depended; for the maximum possible operating voltage of a line is linked up with occurrences of the corona effect and they, in turn, are directly conditional upon the conductors arrangement.

Once this first problem had been solved, it became necessary to define and co-ordinate the insulations of the various parts of the system so that the manufac-

A special article recommended for publication by the AIEE Research Committee.

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turers could make a complete study of the various equipments.

TWO TYPES OF CONDUCTOR ARRANGEMENTS

FROM THE VERY BEGINNING two methods of converting the line were contemplated: (1) dismantling the six conductors of the original line, with two 225-kv circuits in flat formation and putting in three new conductors of an outside diameter suitable for the new voltage—this diameter remained to be determined; (2) regrouping the six original conductors in three bundles of two conductors, which avoided dismantling the conductors and saved considerable time in the conversion operation. The idea of using bundles of conductors to limit the corona effect on very high-voltage lines had already been put forward. Some experiments had previously been made with this type of arrangement, but it had not yet been applied in industry at all.

It will thus be readily understood that systematic research was necessary to study the hitherto little-known properties of the conductors in bundles on the one hand and to determine the type and diameter of the large conductors on the other hand; and finally, to compare the two methods and reach a final choice of conductor arrangement and of the maximum operating voltage of the line.

For the purpose of carrying out this research, the experimental 500-kv station at Chevilly[2] was built and commissioned at the end of 1946. Two auxiliary stations were subsequently erected, one at Alpe d'Huez, the other at the summit of the Puy de Dôme.

THE EXPERIMENTAL STATIONS

THE MAIN TEST STATION, built in the neighborhood of Paris near the Chevilly 225-kv station, was constituted by a normal 380-kv line span, that is to say, by two standard suspension towers 500 meters (550 yards) apart, carrying three phases in flat formation, the distance between centers being 14.50 meters (47.5 feet). The span was fed by a set of three single-phase transformers which enabled the phase-to-phase voltage to be varied from 290 to 500 kv by means of off-load tap changers.

Inasmuch as certain of the future French lines would have to pass over mountain massifs, two identical test stations were built for the study of the influence of altitude on the corona effect. Each of them comprised an experimental span of 100 meters (328 feet) fed at a line-to-ground voltage of 130 kv; one was sited at Chevilly, close to the main experimental line, at an altitude of 100 meters (328 feet), the other at Alpe d'Huez in the Alps, at an altitude of 1,850 meters (6,070 feet).[3]

In addition, with a view to studying the action of the wind as well as the influence of icing on lines equipped with single conductors of large diameter or bundles of conductors, a special test station was erected on the summit of the Puy de Dôme in the Massif Central, at an altitude of 1,465 meters (4,800 feet).[4] This site was selected because it was perpetually windy and, moreover, particularly favorable to the formation of sleet throughout the winter. The station comprised 6 parallel lines, each with a span of 200 meters (220 yards).

FUNDAMENTAL RESEARCH ON THE CORONA EFFECT

WITH A VIEW to this research work, the experimental station at Chevilly was equipped with a series of devices for measuring the corona losses, a particularly delicate operation because of the very low power factor of the line current. These measurements were made point by point so that curves of losses as a function of the voltage could be plotted, by continuous recording at constant voltage for the study of the influence of atmospheric and weather conditions on the losses, and, finally, by metering for the determination of the average losses over long periods.

On the other hand, for the study of radio interferences instruments measuring the strength of the interference fields at radio frequencies were available.

This research lasted for 8 years, during which time a considerable amount of data were collected. At the same time, extensive theoretical studies were carried to a successful conclusion. Thanks to all this work it became possible to make a thorough analysis of the mechanism of the corona effect and its two tangible but not very well correlated manifestations—the losses of electric energy and the radio disturbances. It was also possible to bring out the very different behavior of single conductors and bundles of conductors and to furnish reasonable explanations for each.

The results of this research have been given in numerous publications[2,3,5,6] of which not even a brief summary can be given here. However, the essential conclusions reached with regard to the design of the future French 380-kv lines can be stated:

1. The French convertible line equipped with bundles of two conductors of a diameter of 26.4 mm (1.04 inches), with phases spaced 14.50 meters (47.5 feet) apart, can be operated at a maximum voltage equal to at least 420 kv. At an average voltage of 400 kv, the estimated annual average of corona losses (allowing for variations in atmospheric conditions) is definitely below 1 per 100 of the surge impedance load of the line (500 mw). As to radio interferences, their level measured beneath the line will be of the same order of magnitude as that which can be measured beneath the 225-kv lines now in service equipped with a 26.4 mm (1.04 inches) conductor per phase.

2. The corona losses and the interference field vary as a function of the spacing between conductors in the same bundle. The optimum corresponds to a distance of the order of 15 to 20 cm (6 to 8 inches). However, losses and interference increase very little when this spacing is increased from 20 to 40 cm (8 to 16 inches). On the contrary, it is advantageous to increase this spacing as much as possible, for reasons of a mechanical nature which will be explained later.

3. The losses and the interference field increase when the distance between phases is reduced. With a spacing

of 10 meters (33 feet) losses and interferences at 420 kv remain acceptable, if need be, with a bundle of two 26.4 mm (1.04 inches) conductors, but it is advisable to increase this diameter.

4. As far as the corona effect is concerned, it makes absolutely no difference whether the two conductors in the bundle are placed side by side horizontally or vertically one below the other.

5. From the twofold viewpoint of losses and radio interference, similar results can be achieved by equipping the line with single conductors of an outside diameter equal to 42 mm (1.65 inches) at least.

6. However, to obtain good performances with single conductors of large diameter it is essential to take the necessary precautions to avoid dislocation of the strands in the outside layer of the cable when it is being installed. In this respect different types of "hollow" or "expanded" cables (i.e., cables with voids or plastic fillings) have given bad results, particularly when the outside layer is composed of flat wires.

7. From this point of view conventional stranded conductors are definitely preferable. As has already been stated, for a maximum voltage of 420 kv a diameter of 42 mm (1.65 inches) is acceptable, to which a total aluminium-steel cross-sectional area of 1,039 mm² (2,050 MCM) corresponds, and this figure is reasonably close to the economic optimum for the loads to be transmitted.

8. An advantage of the bundle of conductors as compared with the single conductor is its lower inductance and higher capacitance. The surge impedance load of the line with a bundle of two conductors is approximately 25 per cent higher than that of a line with single conductors. Conditions of stability being equal, the transmission capacity is increased by almost as much.

9. Economic comparisons of lines with bundles of conductors and lines with single conductors, the total cross-sectional area being equal, show that the former are slightly more advantageous. The line with bundles of cables is a little more expensive as it presents a larger area to the action of the wind, but this extra cost is amply offset by the saving on supplies of reactive power required to regulate the voltage.

10. Although for voltages in the neighborhood of 400 kv there may still be some hesitation between bundles of two conductors and single conductors in spite of the advantages of the first system, this no longer holds true in the case of substantially higher voltages of the order of 500 or 600 kv or more. If single conductors were to be used for such voltages, their large diameter would make the cables very difficult to handle and their cross-section would be thoroughly uneconomic. As a matter of fact, experience has shown that nothing is to be gained as far as the corona effect is concerned by increasing the diameter beyond a certain value of the order of 45 to 50 mm (1.8 to 2 inches). In practice, it will only be possible to achieve these extremely high voltages by using bundles of three or four conductors.

11. Comparative measurements taken in the mountains and on the plain[5] have shown that corona losses increase rapidly with altitude, because of the loss of density and, therefore, of dielectric strength of the air. As to radio interferences, they should follow a similar law, but in reality the opposite phenomenom has been observed. This result has been attributed to the fact that mountain air is much less polluted than the air in the urban district round Paris. In any event, the sections of French lines which pass over mountains are so short there is no need to devote much attention to the effects of altitude.

MECHANICAL BEHAVIOR OF BUNDLES OF CONDUCTORS

THE USE OF BUNDLES of conductors raised the problem of accidental contacts between conductors, which can be stated as follows:[2]

1. If the wind is very strong and above all boisterous, it may happen that its unequal pressure on the two conductors brings them into contact with each other, and because of the effect of the aerodynamic slipstream set up by the conductor taking the first impact of the wind there is then the risk of their clinging together.

2. On the other hand, if a short circuit occurs on the network, the conductors may touch each other and cling together even in the absence of wind, because of the electrodynamic forces set up on each other by the two conductors carrying equal currents traveling in the same direction. Even elimination of the short circuit may not suffice to separate them if the current still remains strong enough.

Now, contacts between conductors and especially their clinging together is likely to damage the surface of the outside strands of the cables. To avoid both of these occurrences spacers have to be placed at intervals to prevent the conductors approaching each other.

Two questions thereupon arose: (1) the comparison in this respect of the horizontal and the vertical layout of the bundle, and (2) the number of spacers per span to be provided in each case.

The action of the wind was studied by means of distance recorders and recorders of impacts between conductors in one and the same bundle, both in Chevilly and at the Puy de Dôme station. Tests were also made in a wind tunnel.

Movements towards each other and clinging together owing to electrodynamic action were studied, first at Chevilly, then at the Fontenay Research and Testing Station, by passing suitable currents through the bundled conductors. Static tests at constant current and at progressively variable current, as well as dynamic tests with sudden switching on and off of the current, were carried out.

Another very important problem was that of icing of large diameter single conductors and of bundles of two conductors. Experiments on this subject were made at the Puy de Dôme station, especially built for this purpose.[4,5] Throughout several successive winters a study was made of the formation of ice sleeves on the

various conductor arrangements and of the effects on the conductors and their accessories of the overloads thus caused.

One of the points to which particular attention was devoted was the risk of one conductor of the bundle twisting round the other either owing to a sudden fall of ice from one of them or to successive icing and de-icing. Such phenomena were observed at the Puy de Dôme station. An attempt was also made to reproduce them in Chevilly in tests in which the load of ice and its release were simulated. In some instances the cables remain twisted together, which is a serious drawback.

The essential results of this whole series of tests are as follows:

1. When the conductors are arranged vertically one above the other, the risks of their coming into contact with each other and clinging under the action of the wind and short circuits are slight. In theory at least, spacers can be dispensed with if the conductors are spaced 40 cm (16 inches) apart.
2. When the conductors are arranged side by side horizontally, these risks are much greater. With the same spacing at least 3 spacers per 500 meters (550 yards) span must be provided.
3. With both arrangements there is the risk of conductor twisting if a load of ice is removed; it is perhaps slightly greater when the conductors are placed one above the other. The use of spacers tends to attenuate it, provided they do not link the two conductors rigidly.
4. Generally speaking, the spacers must be most carefully designed both so as to avoid their rapid wear or that of the conductors, and also to prevent the latter winding round each other. They must leave the conductors free to undergo slight movements in relation to each other.

CONCLUSION DRAWN FROM FUNDAMENTAL RESEARCH

The following decisions were taken based on the conclusions deduced from this whole body of research work spread over eight years:

1. The maximum voltage of the network in normal operation was fixed at 420 kv, which coincides with the level standardized by the International Electrotechnical Commission (IEC).
2. For the equipment of the lines after conversion, the method of regrouping the six 26.4 mm (1.04 inches) diameter conductors of the original line in three bundles of 2 conductors, arranged horizontally side by side with 40 cm (16 inches) spacing was adopted. The center-to-center distance of the phases was fixed at 15 meters (49 feet).
3. The number of spacers per span was fixed according to the length of the span and the nature of the terrain (plain or mountain). This number is always 4 at least.
4. For the lines to be constructed subsequently for 380/420 kv, without a first stage at 225 kv, it was decided to reduce the distance between phases to about 10 meters (33 feet) (instead of 15 meters or 49 feet), and to use bundles of two ACSR conductors of a total cross-sectional area of 592 mm² (1,170 MCM), 31.8 mm (1.25 inches) in diameter, spacing between conductors 45 cm (18 inches), horizontal arrangement.

SUBSEQUENT STUDIES AND RESEARCH

Once the aforementioned decisions had been taken, it became necessary to proceed to a whole series of studies and research work preparatory to constructing the equipment and carrying out the installations.

The first of these studies were directed to the regulation of the future transmission of energy. Carried out by means of an a-c network analyser, the studies made it possible to fix the transformation ratios of the 225/380 connecting autotransformers and to determine the characteristics of the reactors to compensate the line capacitance at low loads.

Other studies, made on the micronetwork, related to the dynamic stability of the transmission system, automatic reclosing of the circuit and the protective relaying.

Thanks to very important research work which was successfully carried out with the a-c network analyser equipped as a transient analyser,[7] it was possible to measure the amplitude factor of the overvoltages at 50 cycles of the 380/420-kv network and to fix the maximum switching overvoltage factor of the circuit breakers. These results were the basis of the definition and co-ordination of the insulation of all the transmission components, lines, autotransformers, switchgear, and equipment of stations, as well as the determination of the characteristics of the protective apparatus—light-

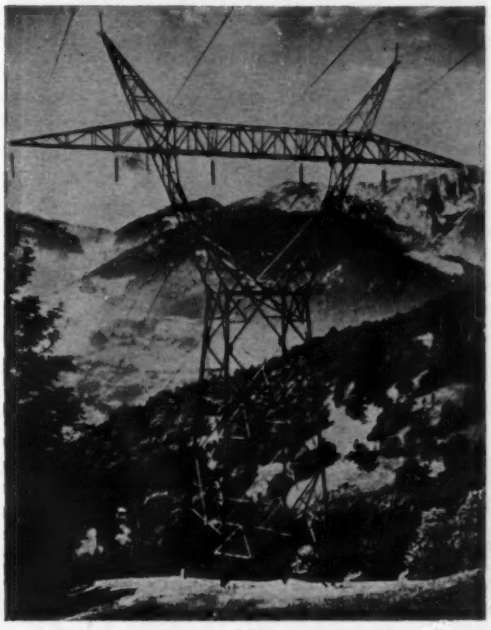

Fig. 1. View of a tower of the convertible line, equipped before conversion with two 225-kv single conductor circuits.

ning arresters and spark gaps. By way of information, the impulse withstand level of the autotransformers was fixed at 1,450 kv.

Other experimental research was done, in particular at the Fontenay Research and Testing Centre, on line insulator strings and their V-mounting, on the suspension bars of the bundled conductors, on the lower arcing rings, the form of which was carefully designed so as to avoid glow discharges, and finally on the spacers, a number of types of which were subjected to thorough trials and severe tests.

FIRST 380/420-KV TRANSMISSION LINE

THE DOUBLE Génissiat–Plessis Gassot 225-kv line, 446 kilometers (km) (278 miles) long, was converted into a single 380-kv line during the summer of 1957.[8] Fig. 1 shows a tower of this line before conversion, and Fig. 2 a tower of the converted line. It came into service at its new voltage in March 1958. In another year the Albertville–Génissiat section, 70 km (43.5 miles) long will also be converted and brought up to 380 kv.

The electrical diagram of the energy transmission line thus constituted, linking the Alps with the Paris district, is shown in Fig. 3. The 380-kv link is connected to the 225-kv network at 4 points by 4 banks of 3 single-phase autotransformers of 300 megavolt-amperes (mva) per bank. They have a delta-connected tertiary winding for coupling the reactors (90 reactive megavolt-amperes [mvar] per station) used to compensate the line capacitance. The rated breaking capacity of the 420-kv circuit breakers is 10,000 mva (symmetrical) and they are designed to ensure rapid autosingle-phase reclosing.

Fig. 2. View of a tower of the convertible line, equipped after conversion with one 380-kv two-conductor circuit.

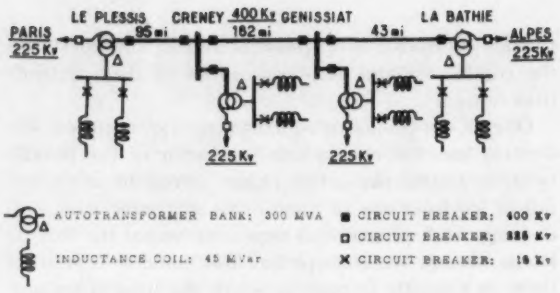

Fig. 3. Electrical diagram of the first 380-kv French line.

CONCLUSION

THE MANIFOLD and prolonged research work dealt with in this article has led to the creation and putting into service of the first stage of the French 380/420-kv transmission system. In fact, those investigations have provided a good number of practical results and theoretical information which may be applied to the field of transmission voltages higher than 420 kv.

The second and concluding part of this article will appear in the June issue.

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Navigational Radar System

A self-contained, long-range navigation device for jet and turboprop airliners, providing for the first time a navigation system that operates anywhere in the world and requires no ground facilities, has been successfully flight-tested. Bendix Aviation Corporation, Baltimore, Md., said the new device is a lightweight compact system based on the Doppler radar principle that has been used successfully on military planes. The system provides jet or turboprop pilot with a direct reading of his true ground speed (as contrasted with air speed), drift angle, actual course over ground, and distance-to-go to his destination.

Current-Limiting Fuses for Semiconductor Rectifiers

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ASSOCIATE MEMBER AIEE

THE RAPID DEVELOPMENT of germanium and silicon power rectifier components in recent years has posed unique problems in fault current protection. These two types of rectifiers are characterized by the extremely high current densities tolerable in the active rectifying element at normal loads while maintaining low forward voltage drop and, thus, high efficiency.

The advantage of high continuous current ratings in a small package produces a handicapping corollary: limited thermal capacity of the rectifying element, the semiconductor p-n junction. Accordingly, junction temperatures climb very quickly when overloads are impressed on the cell. Under fault conditions, during which currents ranging from a few times to several thousand times normal load values may be expected, junction temperatures may skyrocket to destructive values within a few milliseconds or less. Immediate cell failure will occur as materials in and surrounding the junction melt under intensive local heating.

From a thermal standpoint, current-limiting fuse construction is very similar to a germanium or silicon rectifier. The typical current-limiting fuse consists essentially of a high current density fusible element with low thermal capacity connected thermally and electrically to a lower current density heat sink. This similarity in thermal construction between the current-limiting fuse and the semiconductor rectifier leads to similar thermal characteristics and, thus, similar reactions to fault currents up to the point of melting in the case of the fuse and failure in the case of the rectifier cell.

The action of a typical current-limiting fuse is indicated in Fig. 1. The dashed line indicates the manner in which fault current would develop without the limiting action of the current-limiting fuse. If permitted to flow in a typical semiconductor rectifier circuit, the rectifier cells might be destroyed before the current reached zero the first time. However, at some point *A* the current-limiting fuse link melts and the fuse commences to arc. Depending on the fuse design and the external circuit, the current may continue to rise somewhat further to point *B*, the peak let-through current. Beyond this point, the impedance of the arcing fuse forces the fault current down to zero at some point *C*.

It recently has been shown[1] that the forward current capability of semiconductor power rectifiers in the subcycle region assumes an essentially constant $\int i^2dt$ characteristic at times less than a critical value which depends on the specific cell design. At times greater than this critical value, this constant minimum $\int i^2dt$ or I^2t value is conservative. (I = rms amperes, t = seconds.) Current-limiting fuses exhibit similar constant I^2t relationships and can be rated in terms of maximum clearing I^2t.[2]

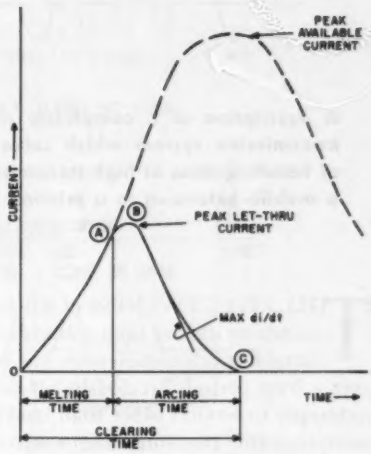

Fig. 1. Limiting action of a current-limiting fuse.

In its simplest form, protection consists of a fuse in series with a semiconductor rectifier. Protection of the rectifier will occur for any subcycle wave shape and magnitude of current within the interrupting ratings of the current-limiting fuse if the maximum clearing I^2t of the fuse is equal to or less than the minimum I^2t rating of the rectifier cell. This basic protection circuit and co-ordination principle applies to any rectifier circuit in which current-limiting action is desired and in which the fault current flows in one rectifier cell path at a time.

In high-current semiconductor rectifier installations in which cells are connected in parallel in each leg of the circuit, and where continuity of operation is essential, current-limiting fuses are used to isolate short-circuited cells from the circuit. With a defective cell isolated in less than a cycle, the rectifier equipment can continue to supply d-c power and, provided adequate load-carrying capacity remains in the leg, the defective cells and fuse may be replaced at the convenience of the operator.

Use of I^2t as the co-ordination medium between current-limiting fuses and rectifier cells eliminates the necessity for complex fault current calculations in the subcycle region.

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A Nonsynchronous System for Mobile Record Communications

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A description of a completely nonsynchronous transmission system which solves the problem of handling data at high transmission rates over a mobile extension to a printing telegraph network.

THE EFFECTIVENESS of synchronous systems for handling data at high transmission rates with reasonable circuit efficiencies has been demonstrated over a long period. Previously, attempts to extend this technique to services other than land-line or fixed plant point-to-point communications circuits have experienced severe difficulties. One of the principal long-term difficulties has been the maintenance of synchronism over the relatively poor communications circuits which generally exist for mobile services. In recent years, several promising approaches have been made toward solving this synchronism problem. One partial solution has been provided through the use of electronic commutation, to obviate the requirement of providing a closely controlled rotational rate for the printing telegraph motor. Other approaches add to this the use of a highly redundant binary code and more sophisticated synchronizing means. A radically different approach is that which depends upon a completely nonsynchronous transmission system. Such a system has been developed by the Bell & Gossett Company in co-operation with the Dualex Corporation and is currently produced under the trade name of the Unitone System. It is this system which will be discussed.

The basic design objective was the provision of a highly reliable mobile extension to a land-line or point-to-point record communications or data-handling system. In order to be completely useful, the system must provide reliable communications for a circuit which would be marginal or completely unusable for other communications services. As a secondary requirement, it should be possible to implement the system without extensively modifying the existing communications circuit, inasmuch as a large portion of the potential users currently have some type of communications system. A brief summary of the desired system characteristics is listed.

1. Because the system would be essentially an extension to a printing telegraph network, the basic coding scheme should be compatible with the conventional five bit printing telegraph code.
2. Circuit reliability requires that the system should employ a slowed-down bit rate for a given transmission rate. This provides an increased sampling period for each bit with a corresponding increase in reliability. This sampling should be provided in a nonsynchronous manner so that the most effective use could be made of the circuit quality which exists at any time.
3. The existing mobile communications circuits are predominately voice circuits; therefore, some type of tone-coded signals would appear to require no equipment modification.
4. Since the system is primarily for mobile applications, a duplex terminal should be provided with low volume, weight, and power consumption.
5. The initial system transmission capacity should represent a reasonable compromise between the requirement for a high-speed data-handling system and the transmission rate which would be required for printed record communications purposes per se. A maximum system capability somewhat in excess of 100 words per minute appeared to be a reasonable compromise inasmuch as it would not require a prohibitive development period.
6. The system should be designed with a minimum of complexity, consistent with the desired performance, in order to minimize maintenance problems.

DESIGN APPROACH

ONE OF THE FIRST PARAMETERS requiring development was that of the specific coding scheme which would be employed. Because the system requirements were based on a five bit code, the coding system obviously must be tailored to this requirement if some auxilary code conversion process were to be obviated. The requirement of a type of tone-coding applied to the five bit code would indicate, as an initial aproach, the simultaneous transmission of combinations of five audio-frequency tones representing the marking condition of each of the five code elements which comprise the printing telegraph code. Although at first glance this would appear to provide "the solution," it is apparent that the advantage of increased sampling period which thus ac-

Essentially full text of paper 59-8, recommended by the AIEE Telegraph Systems Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Winter General Meeting, New York, N. Y., Feb 1-6, 1959. Scheduled for publication AIEE *Communication and Electronics*, 1959.

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crues is essentially nullified by the effective "per frequency" power reduction resulting from simultaneous transmission. In the development program, it was also apparent early that it would be impractical to attempt to utilize the entire character period for sampling since this would require a complex intermediate buffer storage. Thus, if the ultimate performance were to be provided with a minimum of circuit complexity, a different technique would be required. However, it should be noted that a number of prototype units of this so called "Pentone" system were constructed which proved to be very successful for circuits which would normally be considered as marginal for voice communications service.

An evaluation of the relative importance of sampling period vs "per frequency" power indicated that the optimum coding system should use alternate transmission of two equal length audio-frequency tones. This would provide maximum effective signal power per tone and also a sampling period approximately four times as long as that of a five bit start–stop asynchronous system operating at the same over-all transmission rate.

Fig. 1 illustrates the coding and sampling relations between these two types of systems. The first and second phase tones indicated in Fig. 1 are the "bit" frequencies from the two families (four and eight respectively) which are transmitted in a consistent time relation; i.e., one of the frequencies of a first family of four always precedes one of a second family of eight. The correspondence between this coding and the five bit printing telegraph code occurs in the use of a given frequency to indicate the code element combinations. For example, the four first-phase frequencies represent the combinations of code elements 1 and 2 (1-0, 0-2, 1-2, and 0-0). The second-phase family similarly corresponds to the combinations or code elements 3, 4, and 5. Thus, it seems that only two elements are used to convey the information contained in the five bit code resulting in a significant reduction in effective bit rate. At the receiving terminal, in the stand-by condition, the entire first-phase family of frequencies is exposed to the communications circuit. Statistically, the most reliable operation would appear to be provided by the use of a single first-phase conditioning frequency at the expense, however, of requiring a second-phase family comprised of 32 frequencies. The increase in reliability was not believed to be sufficient to justify this large family of frequencies. The optimum compromise between reliability and frequency complement was found to be the use of a first-phase family of four frequencies and a second-phase family of eight frequencies.

In order to derive the maximum performance which can be provided by the nonsynchronous nature of the system, the receiving terminal should employ a variable bandwidth technique; for, as the circuit deteriorates, it should be possible to reduce the transmission rate and, correspondingly, automatically reduce the bandwidth of the frequency detectors at the receiving terminal, thus allowing full advantage to be taken of the longer

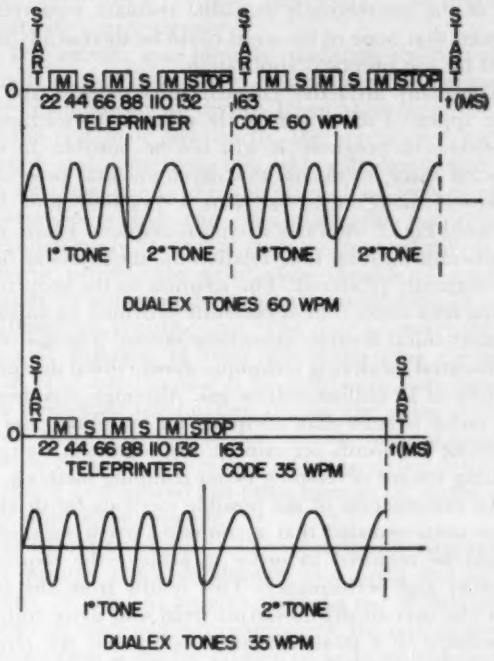

Fig. 1. Comparison of the Dualex tone signal with the five bit start–stop d-c signal.

sampling period. This operational characteristic can be closely approximated through the use of conventional filters and rather complex circuitry. The complete realization of this approach requires that very tight tolerances be maintained on the filter characteristics and various threshold levels. This is difficult to achieve in practice. In view of the complexity of this approach, it appeared to be incompatible with the design criteria. A study of the potentialities of resonant reed relays showed that they inherently possess many of the characteristics which are required in the provision of a variable bandwidth system of minimum circuit complexity. This comes about largely from the fact that the output of these relays is a sequence of low impedance contacts which occur at well-defined threshold levels. The absolute value of this threshold is directly dependent upon the method of applying the driving signal. Also, in direct analogy to conventional filters, the response time is inversely proportional to the bandwidth. Thus, it is readily appreciated that the principal ingredients for a variable bandwidth system are inherent in the intrinsic device parameters. One of the characteristics which make the reed attractive, namely the very high effective "Q," make it impossible to realize keying rates in excess of a few words per minute. The bandwidth-buildup characteristics can readily provide acceptable bandwidths for rise times which are adequate for transmission rates well in excess of 100 words per minute, but the mechanical "Q" of the reeds is sufficiently high so that the reed may never be completely at rest at keying rates over 50 words per minute. The

net result is a very erratic buildup time. Extensive testing of the commercially available resonant reed relays showed that none of the units could be successfully utilized for the proposed application.

The many attractive characteristics of this type of unit appeared to be sufficiently valuable to warrant a development program. It will not be possible, in the allotted space, to discuss this developmental program; however, suffice it to say that a practical unit has evolved. Fig. 2 indicates a typical response curve and bandwidth built-up time relation for the relays as they are currently produced. The solution to the reduction of the reed decay time is currently provided by an electromechanical friction quenching system. The use of a noninertial measuring technique shows typical damping periods of 10 milliseconds or less. Although this damping factor is more than adequate for sampling rates in excess of 100 words per minute, investigations are continuing toward developing better damping methods.

An examination of the possible methods for driving these units revealed that a constant-current technique would be required in order to achieve the requisite stability and performance. This results from the fact that the over-all driven circuit (reed and drive coil) is responsive in a dual resonant mode about the physical resonance of the reed, so that the impedance of the reed drive coil undergoes a significant fluctuation as the generator frequency is varied through the resonant frequency of the reed. The over-all reed performance is improved, for certain conditions, when the coil circuit is electrically resonated. Caution must be exercised in establishing the tuning criteria because of the intimate relation between the physical resonance of the reed and that of the reed drive coil. It is interesting to note that the over-all tuning procedure, which has been utilized for the reed relays for this service, constrains the response characteristic to one which is essentially symmetrical about the resonant frequency rather than the geometric response which would be anticipated for this type of resonant circuit.

Determination of the range of transmission rates to be accommodated by the system immediately fixed the limits for the reed threshold level and correspondingly, the effective individual bandwidth. The design criteria for accommodation of transmission rates from approximately 5 words per minute to 100 words per minute indicated that reed threshold response periods ranging from approximately 700 milliseconds to 25 milliseconds would be required. The resulting maximum bandwidth of approximately 25 cycles allowed for a minimum frequency separation of 40 to 50 cycles, provided that a definite upper limit is placed upon the amplitude of the drive level. The adjustment procedure which is utilized for the relays results in a threshold-bandwidth-drive level relationship which is essentially independent of the center frequency. As a result of the essentially constant bandwidth, a constant frequency separation of approximately 43 cycles was chosen in lieu of the usual logarithmic separation. The adjustment procedure which yields this constant bandwidth characteristic does result in a variation in absolute sensitivity; i.e., the nose of the response characteristic, which is inversely proportional to the center frequency. This variation in absolute sensitivity becomes the factor which limits the operation under extremely degraded circuit conditions so that it is not feasible to decrease the transmission rate below approximately five words per minute.

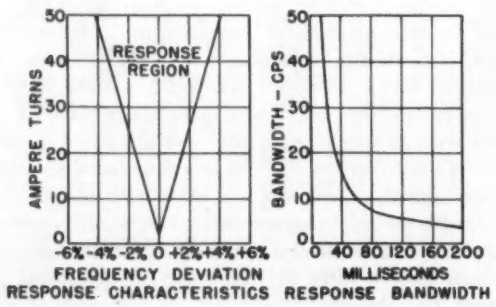

Fig. 2. Resonant reed relay characteristics.

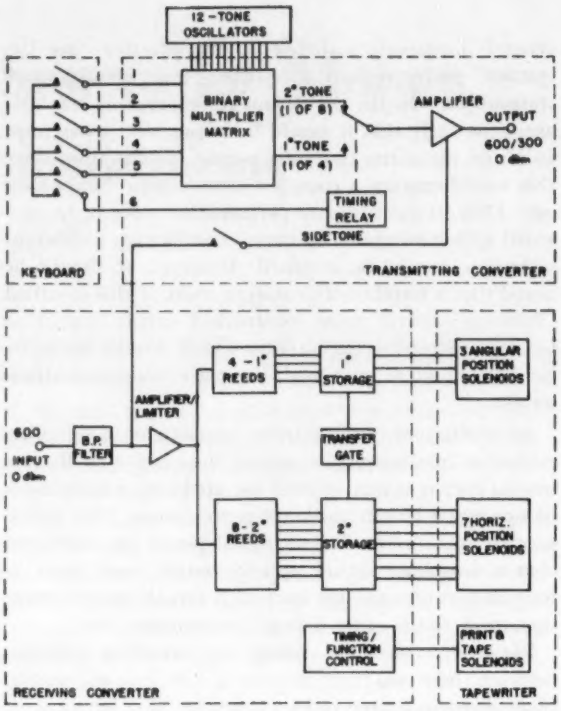

Fig. 3. Simplified block diagram of duplex terminal.

The remainder of the development effort was concentrated on the terminal equipment circuitry and printing system. Because the two programs required radically different approaches, they will be discussed separately.

TERMINAL UNIT

FIG. 3 SHOWS the simplified block diagram of a typical duplex terminal. Entry to the transmitting converter is

on a parallel basis, and is normally accomplished by contact closure of the five code switches on the keyboard or tapereader. The sixth switch performs a dual function of actuating the timing relay and providing simultaneous output of the five code element switches without requiring individually precise adjustments. The 5 code switches drive 5 relays the contacts of which are arranged in a double "pine tree" matrix deriving the 32 function code.

These contacts select the output of a pair of oscillators the frequencies of which correspond to the function that has been selected by the keyboard or tapereader contact combination. The timing relay sequentially switches the amplifier input between the output of the first-phase matrix and the second-phase matrix so that the unique time sequence is maintained. When the input is generated by a tapereader or, if manually generated by a trained operator, the time division between the first- and second-phase frequencies is sufficiently accurate so that auxiliary timing circuits are not required. When it is anticipated that relatively inexperienced operators will be operating the circuit, an auxiliary plug-in timing relay is utilized. This relay limits the length of the first-phase tone and thus minimizes the effect of operator timing error. The amplifier output is squelched during the stand-by period so that there is no possibility of tone leak-through interfering with circuits which are used for voice communications on a shared-time basis. A normally open contact is also provided for use with those equipments having a "push to talk" mode of operation. This circuit has a release delay of approximately 750 milliseconds, providing for no carrier interruptions for keying rates in excess of approximately five words per minute. Inasmuch as the normal installation would be on existing voice circuits, the nominal output was chosen as 0 dbm (decibels referred to one milliwatt). Provision is made for monitoring the transmitted copy by means of a side-tone amplifier the output of which is well in excess of the input threshold of the receiving converter.

The receiving converter consists of three basic subdivisions: the preliminary filtering and amplification, which provides the drive for the reed detectors; the frequency determining elements, reed detectors; and the storage and timing circuits. It will be noted in Fig. 3 that a limiter–amplifier combination is used to provide the drive to the resonant reed relays. The reason for this is twofold. First, in order to preclude the possibility of printing erroneous characters, driving power must be limited to prevent the reed threshold from being raised to the point where a given reed responds to adjacent frequencies. Second, the quasi-capture effect of a broadband limiter increases the effective signal-to-noise ratio if it is greater than unity and depresses the reed signal power for signal-to-noise ratios less than unity. This limiter effect tends to reduce the drive to the reed detectors and, correspondingly, the acceptance band for signal-to-noise ratios less than unity so that the effective bandwidth is essentially proportional to the signal-to-noise ratio. Thus, the desired variable bandwidth system performance has been approximated by means of relatively simple circuitry.

The transfer gate initially conditions the first-phase family of reed detectors so that all four are exposed to the communications circuit. Upon recognition of one of the first-phase frequencies, the appropriate code is stored and, simultaneously, the gate conditions the second-phase family of frequencies. Upon recognition of a second-phase frequency, this information is stored and simultaneously the print cycle is initiated. With the present printer, the print cycle consists of approximately 50 milliseconds positioning time, plus 25 to 30 milliseconds printing time. The time necessary for the over-all sequence of relay operations plus the print cycle time requires that it be possible to store succeeding first-phase information during the print cycle in order to achieve transmission rates in excess of approximately 85 words per minute. This is accomplished by utilizing a compound first-phase storage; i.e., buffer storage plus output storage.

It will be noted that a 12-wire output is required by the printer (10 code element plus print and return leads). In order to accommodate the use of tape perforators or other auxiliary equipment, the output storage incorporates a binary divider so as to provide a five-wire parallel output. It should also be pointed out that inasmuch as the storage is accomplished by means of relays, the circuit is arranged so that only two heavy-duty relays make or break the output current, thus reducing contact wear.

As a consequence of the high use factor for the radio-frequency spectrum, the incidence of cochannel and adjacent channel interference is quite high. In order to provide protection against interfering components falling within the signal band, an additional timing circuit was incorporated in the transfer gate. The function of this circuit is to clear the first-phase storage if a second-phase frequency is not recognized within a certain period of time. This time is determined by the length of the first-phase frequency; thus, the period which is allowed before clearing is determined by the effective transmission rate. This circuit has greatly reduced the sensitivity of the system to interfering signals although it is manifestly impossible to preclude such errors completely by this approach.

Early in the design program, it was quite evident that a stabilized low-impedance voltage source would be required for the gating and timing functions. This is provided by a regulated supply whose output impedance is less than 5 ohms for a frequency range of d-c to 200,000 cycles so that no instability results from any pulses which may be encountered.

PRINTER

It was initially decided that the over-all system requirements dictated a fresh approach to the printer problem rather than attempting a modification of an existing unit. After thoroughly exploring the many possible approaches, it was decided that the requirement

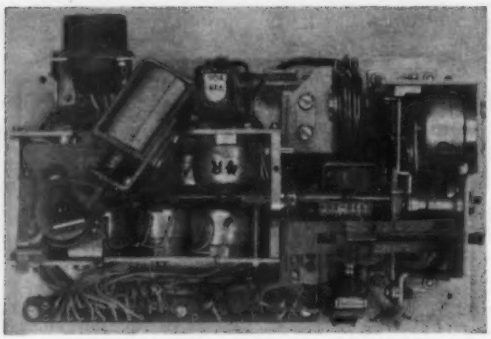

Fig. 4. View of tapewriter with cover removed.

for satisfactory operation under difficult evironmental condition plus the requirement for minimum size, weight, and power consumption could best be met by a tape printer configuration. The basic mechanism consists of rotary solenoids driving a type segment arranged in a 4 by 8 matrix. This approach results in minimum power consumption inasmuch as no power is required except during the printing operation. The type segment arrangement as a 4 by 8 matrix, requires seven active horizontal positions and three active angular positions. The seven rotary solenoids and associated linkage which constitute the horizontal subassembly are in the left foreground of Fig. 4. The angular positioning subassembly, which consists of the three solenoids and associated linkage, comprises the assembly at the extreme right. It will be noted that the type font is reversed so that the tape is between the operator and the type font. This configuration provides maximum visibility. In order further to reduce the mechanical movements to a minimum, the conventional paper tape plus inked ribbon combination has been discarded in favor of impact sensitive tape. Upper- and lower-case selection (figures-letters shift) is accomplished by rotating the tape guide 11 degrees. This subdivides each of the 32 type font positions into either the figure or letter characters.

RESULTS AND CONCLUSIONS

A TYPICAL DUPLEX TERMINAL developed by the program described is shown in Fig. 5. The converter and power supply are packaged in the standard Air Transport Rack configuration since it was anticipated that initial use would be in an airborne environment because of the stringent communication requirements of this service. The major objective of the design program was the development of a system which approached the performance capability of the basic concept, making it possible to acquire a useful quantity of data from actual field service. A miniaturization program is being initiated which should result in significant improvements in the over-all performance and major reductions in the displacement, weight, and power consumption. The maintenance-free life should also be greatly extended because solid-state switching is planned for all of the circuits.

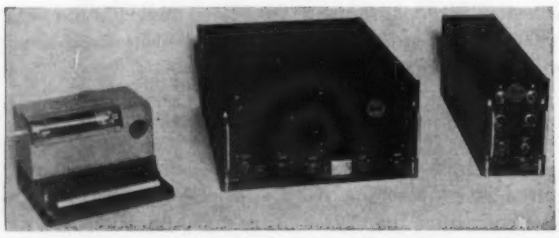

Fig. 5. Type U2-A airborne terminal.

The over-all system performance has been extensively measured in the laboratory. The results of a typical test are shown in Fig. 6. This test utilized a white noise source, band limited to the signal band by an *L-C* filter with 40 db per octave skirt selectivity. The rms noise envelope is plotted vs the maximum transmission rate for an error count equal to or less than 1%. It will be noted that the curve directly shows the quasi-capture

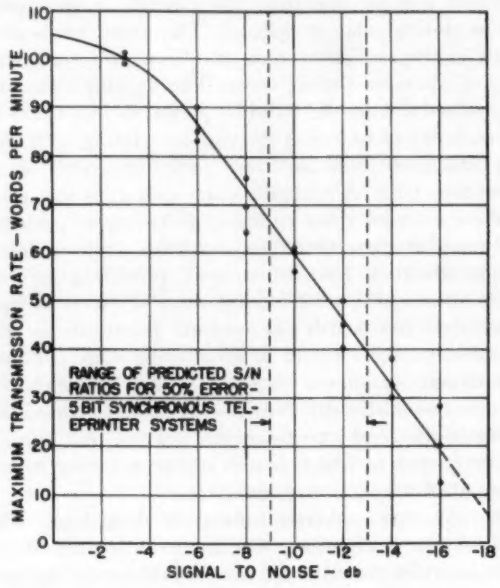

Fig. 6. Maximum transmission rate for 1% error.

effect of the limiter on the reed detector bandwidth and corresponding threshold build-up time. It will also be noted that the deviation from the logarithmic relation between the signal-to-noise ratio and channel capacity increases at the higher transmission rates because of the maximum speed capability of the system. The zone which is shown as 50% error for five bit synchronous systems is the predicted signal-to-noise ratio for this maximum error rate as described by Masonson and Montgomery.[1, 2] The indicated range includes both amplitude modulation and frequency shift keying for noise, band limited to the transmission band. Although the predicted performance of the binary system is based

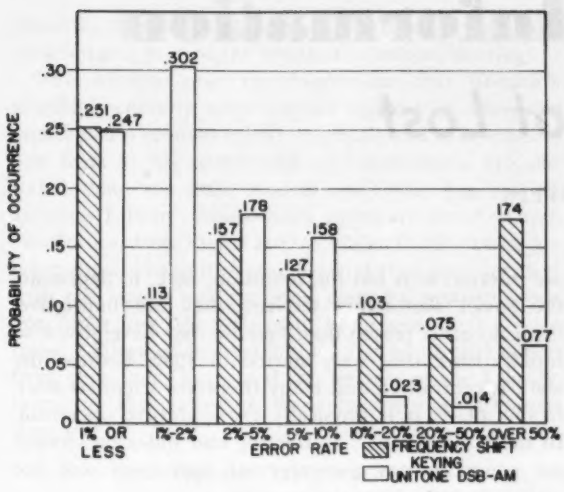

Fig. 7. WADC flight tests—1956.

on several simplifying assumptions, the improvement in performance which is provided by the nonsynchronous approach is believed to be significant.

The "proof of the pudding" for any system, of course, is the performance under actual circuit conditions. The system has been flight tested by the U. S. Department of Defense with various test objectives.

One such test was conducted by the Communications and Navigations Laboratory at Wright Air Development Center during June and July 1956.[3] The test was conducted to compare the performance of the Unitone system with that of a frequency shift keying teleprinter system. A total of 74,362 characters, for each mode of transmission, were retained for scoring purposes. The general conclusions resulting from the test programs were: for good circuit conditions, the performance provided by both techniques was essentially equivalent; however, for deteriorated circuit conditions, the Unitone system, in the aggregate, provided a better "per character" reliability of between 15 and 25%. The results of the flight-test program are shown in Fig. 7. The data is presented as probability of occurrence for various error rates for each mode of transmission. The error rates are grouped logarithmically since this provides the best indication of the over-all system usefulness. As would be expected for error rates of 1% or less, the two systems provide an equivalent probability which indicates simply that for a reasonably good transmission medium, the choice of technique is not too important; however, for deteriorated conditions the differences are more pronounced. For example, the Unitone system, for the wide range of circuit conditions, exhibited the highest probability for error rates of 1 to 2% with the probability of higher error rates decreasing rapidly. The frequency-shift keying system on the other hand exhibits a probability peak for a 2 to 5% error rate with a relatively gradual decrease in probability for higher error rates. It is also informative to compare the probability of occurrence for error rates in excess of 50%. Although, it would certainly be a grave error to draw sweeping conclusions from the limited test data, it is believed that they are an indication of the potentiality of this technique.

The system which has been described in the foregoing sections is currently being produced for use by the Air Defense Command as the primary air-to-ground communications system for the Airborne Early Warning environment. As part of this program, a duplex serial to parallel adapter has been developed and is in production for installation in the ground environment. The adapter provides direct entry into a conventional start-stop five bit telegraph system. Decreased maintenance requirements are provided by the use of modular packaging techniques and solid-state circuitry throughout.

The laboratory testing and, to date, somewhat limited flight testing of the Unitone nonsynchronous system indicates that this approach provides increased reliability for difficult communications circuits. The equipments which are currently under development, should provide even better performance which more closely approaches the ultimate system capability.

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1906 George Westinghouse
1907 Alexander Graham Bell
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Article appears on page 312.

Engineering Information

All Is Not Lost

R. H. PHELPS

A review of the activities and services of the Engineering Societies Library. Its unique documentation center and unrivalled search facilities have earned it world-wide reputation and use.

MORE OR LESS CONTINUALLY, one is confronted with statements that the recent growth of the scientific and technical literature has been so great that its use is impracticable, if not impossible. In a general sense, this idea goes back to the Old Testament which says[1] "Of making many books there is no end." In the 1890's, when the Royal Society of London was contemplating the publication[2] of "The International Catalogue of Scientific Literature," the increasing amount of the literature and the difficulty of its use were deplored.

THE SOVIET CHALLENGE

ANOTHER TOPIC since the advent of the Sputniks is the extent and excellence of Soviet abstracting services —often with the implication, if not the statement, that abstracting and indexing services in the United States are inferior. It is not the intention, here, to depreciate the Soviet abstracting services; they are impressive, if for no other reason than because they have grown so rapidly since they were started in 1952. Because the work is centralized and many literature scientists work in one place, it is physically an impressive operation. In the United States, abstracting and indexing services are generally not governmental operations and are scattered throughout the country.

If the Soviets have profited more than we have from the technical literature, one may believe that they have worked harder at using it. The Soviet centralized information services are not essentially better than the services available in this country. Some of the larger sections of the Soviet abstract services have no subject indexes and are therefore very difficult to use.

Over here, mechanization is being studied as a means of reducing the time and cost of the handling and retrieval of literature. For small collections of literature in restricted subject fields, mechanization has sometimes proved satisfactory. For large collections in broad fields covering diverse subject material including concepts as well as materials, mechanization is apparently many years away. Its current status and some of its many problems and difficulties have been pointed out by Warheit,[3] Taube,[4] Shaw,[5] and Rabinow.[6] The over-all problems of getting the information ready for the machine and getting it from the machine are perhaps greater than the development of the machine. Machines work best on repetitive and routine operations. Such operations are not common in literature handling and retrieval.

Everyone wishes that the literature could be searched more quickly and at less cost. Efficient mechanized systems for large collections are not now available—not even at the very high prices charged for the large computers, which are now being promoted for literature search work despite the fact that they were designed for other work and are not particularly efficient as literature searching tools.[4]

Despite all this, the technical literature can be and is being effectively used. Our present abstracting and indexing systems may not be all that their publishers or users would wish them to be; but none of the many abstracting and indexing services available in the En-

Essentially full text of a paper presented at the annual meeting of The American Society of Mechanical Engineers (ASME), New York, N. Y., Nov. 30–Dec. 5, 1958.

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gineering Societies Library is years behind, as was stated by a witness at a recent Senate Committee hearing[7].

The witness gave the impression that literature searches generally take a great amount of time (he mentioned 6 months as one example) and that searches cost from $1,000 to $100,000 and even more. He also stated that "the little man is out." The Engineering Societies Library makes many literature searches each year for fees from under $100 to under $1,000. These are not complete literature searches and they may not deal with the largest and the most complex problems, but how often does "the little man" or anyone else deal with these? Letters of commendation, and additional orders from those who have used the services of the Library, attest to the value of these inexpensive literature searches.

THE LIBRARY: ITS BACKGROUND

THE ENGINEERING SOCIETIES LIBRARY was established in 1913 through the merging of the long-established libraries of the American Society of Civil Engineers (ASCE), the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME), The American Society of Mechanical Engineers (ASME), and the American Institute of Electrical Engineers (AIEE).

The Library is outstanding in its coverage of the fields of civil, electrical, mechanical, mining, metallurgical, and petroleum engineering. It also extensively covers chemical engineering and all other branches of engineering, primarily on the level of the graduate and practicing engineer. The Library contains over 175,000 volumes, 20,000 maps, 5,000 translations, and 10,000 bibliographies and indexes. Some 1,500 periodicals are currently received from all parts of the world; about one third of these are in foreign languages. Recently the coverage of Soviet and other Eastern European scientific and technical publications has been expanded, and important publications are continually added.

In addition to collecting extensively, but selectively, engineering publications of all types on a world-wide basis, the Engineering Societies Library maintains complete files of all technical publications and papers of AIEE and of the other Founder Societies. Its collection of their unpublished papers is particularly important, for most of them are manuscript copies not elsewhere available, not even in the Societies' own files.

After stocks of their publications are exhausted, the Founder Societies refer inquirers to the Engineering Societies Library for photoprint or microfilm copies. Often, this is done simply by transferring the inquirer's letter or order directly to the Library. We believe that this practice is the best way to serve with the least possible delay.

Each issue of *Electrical Engineering* contains a list of "Books Received in the Library." These are some of the over 600 brief book reviews prepared each year for the journals of the Founder Societies so that members may learn about new books in their field. Most of these books, as well as others in the Library, may be borrowed by members of AIEE and of the other Founder Societies.

The services of the Engineering Societies Library also include a reading room open 6 days and 5 nights a week for most of the year. It is staffed by persons having library and technical training.

LITERATURE SEARCHES

THOUSANDS OF REQUESTS from members for brief information which can readily be located are answered without a charge. For members and others requiring extensive information, literature searches and bibliographies are made, for a fee, to the specific requirements of the inquirer. The service ranges from recommending books on a specific subject to the preparation of comprehensive annotated bibliographies of books, articles, and reports. Searches are also made for disclosures related to patents. All search work is kept confidential.

The Library's staff also prepares bibliographies on subjects of general engineering interest. These may be purchased by anyone. A list is available on request.

Translations of engineering and technical articles are made from all languages into English by "consultant" translators who are familar with engineering. All translations are reviewed by a member of the staff of the Library to insure accuracy of translation and the quality of the English.

Photoprint and microfilm copies of the material in the Library are made on request.

All of the foregoing services, except loans of books to members, are available to anyone. They are used by engineers, scientists, technologists, and industry in this country and throughout the world. More than half of the users of the Engineering Societies Library do not come to the Library but use it by mail, telephone, and telegraph.

Joint ownership and support of the Engineering Societies Library by the Founder Societies is achieved through the United Engineering Trustees, Inc. (UET), an organization established by the Founder Societies to own and operate the Engineering Building. The Library is a department of the UET, as is also the Engineering Foundation.

THE ENGINEERING INDEX

THE ENGINEERING INDEX, now in its 74th year, is an internationally accepted digest of technological literature prepared for engineers, research workers, and students. The Index and the Library, although separate organizations, co-operate closely. All publications received by the Library are made available to the Engineering Index, which is housed in the same building. Through the Index, the Library has a ready-made published index to articles in periodicals and other publications in the Library. This unique arrangement is of great value to engineers and industry.

The Engineering Index reviews 1,400 leading periodicals and society transactions, as well as a substantial

number of bulletins and reports of Government bureaus, research laboratories, technological institutes and colleges, and other agencies. Last year the service provided annotated references to 27,000 articles. The Index issues a weekly card service in 255 subject divisions. Subscriptions may be placed for single subject divisions, for groups of divisions, or the entire card service. The cost of the divisions ranges from $12.00 to $45.00 each, with a total cost of $1,500 for the complete card service. Educational institutions receive a discount. The Index subsequently appears as a bound volume cumulating all of the references for the year. The charge for this bound volume is $70.00. In 1957, the Soviet Union purchased 54 copies of the 1956 bound volume of the Engineering Index.

NEW FACILITIES

Looking to the future, the co-operative information activities of the Engineering Societies, the Library, and the Index will continue to grow. The American Institute of Chemical Engineers (AIChE) has recently become the fifth Founder Society. It is expected that other societies will join in the support of the Library when the Societies move into the new United Engineering Center to be erected near the United Nations in New York City. The better facilities and the broadening base of support and interest should lead to increased and better information services for the engineering profession.

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Operating Experience with the Vallecitos Boiling Water Reactor

L. KORNBLITH, JR.
ASSOCIATE MEMBER AIEE

W. A. RAYMOND

The Vallecitos Boiling Water Reactor, in addition to being a power-producing plant, has the fundamental purpose of providing a facility for testing fuel and operating components for other reactor plants. Methods of operating and staffing, as well as maintenance experience and problems, are discussed.

BUILT during the period June 1956–June 1957, the Vallecitos Boiling Water Reactor (VBWR) went critical in August 1957. The generator was first paralleled with the Pacific Gas & Electric Company system on October 19, 1957. The plant consists of a light-water-moderated and cooled boiling reactor producing steam at 1,000 psi (pounds per square inch). This steam is reduced in pressure to 450 psi and then is used directly in a 5,000-kw turbine.

The project is located at the Vallecitos Atomic Laboratory of the Atomic Power Equipment Department of General Electric Company, near Pleasanton, Calif., about 40 miles southeast of San Francisco. The reactor was designed and built and is being operated by the Atomic Power Equipment Department of the General Electric Company. The Pacific Gas & Electric Company joined in the project by supplying and installing the steam utilization section of the plant and is now operating that section of the installation and using the electric power in its network. The entire plant, as well as the rest of the Vallecitos Atomic Laboratory, was built entirely with private funds, and is the only operating nuclear power plant so financed.

The decision by General Electric to build this plant was based on the need to have available to the Atomic Power Equipment Department a facility which could be used to test fuel. Many of the design facets of the Dresden Nuclear Power Plant (described elsewhere in this issue), now under construction in Illinois for the Commonwealth Edison Company, were utilized. The VBWR was designed with a high degree of flexibility to allow easy modification and to facilitate experimental investigations. The reactor is an enriched-uranium boiling reactor. Although the turbine plant is

Full text of a conference paper presented at the AIEE Winter General Meeting, New York, N. Y., Feb. 1-6, 1959, at a session sponsored by the AIEE Nucleonics and Power Generation Committees.

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rated at only 5,000 kw, the reactor is capable of producing substantially higher power. It has, to date, been operated at 30,000 thermal kw and a license to operate at 50,000 kw recently has been issued by the Atomic Energy Commission. It is expected that 50,000-kw operation will be smooth and uneventful, and will pave the way for possible higher power operation.

CORE

THE INITIAL CORE of the reactor consisted of 3-inch-square fuel elements fabricated from thin stainless-steel-clad plates containing a mixture of fully enriched uranium oxide and stainless-steel powder. A portion of this core has since been replaced by various other types of elements. The principal new type of element has been a prototype element for the Dresden plant, consisting of ½-inch diameter rods made of 2.3% enriched uranium oxide pellets clad in zirconium. Nine such rods are assembled into each fuel element. Fourteen elements of this type are now installed in the core for test purposes and more elements will be added in the near future. In addition, a number of elements are being irradiated for outside customers. Reactivity is controlled by seven control rods. These rods are driven by an electropneumatic drive similar to those used in the BORAX reactors. The core is enclosed in a 7-foot diameter vessel 20 feet high, and fully lined with stainless steel. Suitable nozzles are provided for the control-rod drives which come out of the top of the reactor and for the piping and instrumentation. In addition, four 12-inch ports have been put into the top head to allow refueling of the core without removal of the head. The head opening is the full diameter of the vessel, so the entire core and its supports may be removed and replaced if this is desired. The reactor is located below the operating floor of the reactor building. Above the reactor, at the floor level is an 18-inch-thick steel missile and radiation shield which also serves as a mounting for the control rod drives. The shield, which weighs 80 tons, is separated into three parts which are mounted on wheels and rails. For refueling through the 12-inch ports, the two outside sections are rolled back, leaving the center section and control rod drives in place. For removal of the head, the entire shield is rolled aside. The reactor is housed in a 48-foot diameter, vapor-tight steel enclosure, 100 feet in total height. About one-third of the building is below grade. The 4-foot-thick concrete floor at grade level separates the lower area, containing the reactor and associated equipment, from the upper area. Two air locks with 3- by 5-foot doors are provided for access. In addition to the direct-cycle operation, the plant is designed to allow testing of dual-cycle operation, in which a portion of the heat is removed as hot water, and of various combinations of natural and forced circulation. Equipment for this is located in the lower section of the building.

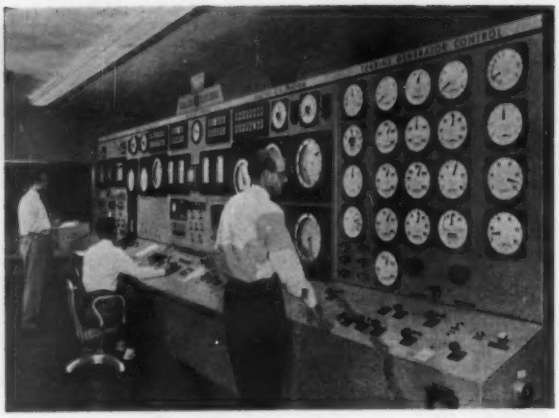
VBWR installation.

Cutaway view of the Vallecitos Boiling Water Reactor installation. Reactor is housed in lower portion of domed building at left, and turbine–generator is shown in building in right background. Entire installation is controlled from central control room shown in right foreground.

TURBINE

THE TURBINE is a type *T-2 SE-A1* marine unit with slight modification to accommodate saturated steam and provide for conventional load control. A de-aerating hotwell has been added to the condenser. With these exceptions, the turbine–generator and condenser are a standard installation. The turbine–generator controls and protective devices are not substantially different from those used in a conventional fossil-fired plant. A 2-story sheet-metal building is used to house the turbine–generator and auxiliaries. The turbine–generator, exciter, and air-removal system are located on the second level, with a connecting walkway to the control room. The ground level contains the lube oil system, reactor feed pump, air compressors, and condenser. A special basement room is provided for the condensate clean-up system. With the exception of the clean-up system and air ejector, no radiation shielding has been provided.

As mentioned previously, the plant first operated on October 19, 1957. At that time, the pump which



Control room of VBWR installation.

was to be used for testing alternative operating cycles was not available. The reactor was shut down early in February to allow the installation of this pump, and to make other modifications to the system. The plant was restarted early in May and routine operation was resumed in June. With this exception the plant has been available for power production substantially all of the time since start-up. There have, of course, been many shutdowns incidental to the experimental programs being performed in the reactor. Despite this lost time, the electric power produced as of December 31, 1958, was over 13.5 million kwhr.

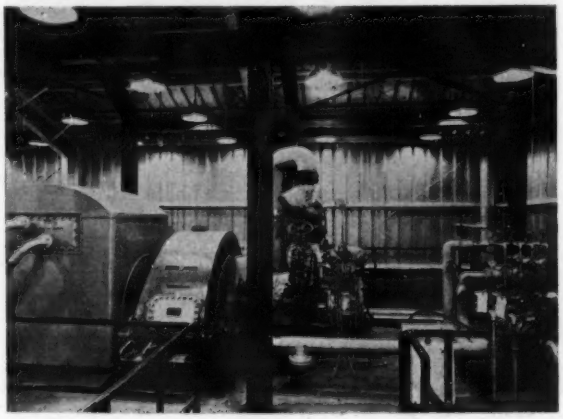
OPERATION FACTORS

THE PERIOD of June through September 1958 has been selected as a typical operating period for the calculation of operation factors. The first of these is the output factor, which is the ratio of actual power generation to the product of actual operating time and rated plant power. The output factors for these 4 months are 0.204, 0.710, 0.849, and 0.549, respectively. The figure for September is abnormally low, inasmuch as the turbine output was curtailed because of high steam-seal pressure. Normal reactor output continued with steam bypassed to the condenser. Availability factors have been computed on two bases, actual and corrected. Actual availability is the ratio of actual operating hours to total time during the period. For the 4 months, these factors are 0.214, 0.633, 0.806, and 0.488. Corrected availability is computed by adding to the actual operating hours the shutdown time imposed by the experimental program. This factor, then, should reflect the availability of this plant if it were used only for commercial service. These corrected factors for the four periods are 0.986, 0.915, 0.963, and 0.642. The availability factors for September are low because of the interruptions from a major fuel-loading change and from necessary feed pump repairs.

OPERATIONAL RESPONSIBILITIES

AS MENTIONED PREVIOUSLY, operational responsibilities for the plant are divided between General Electric and Pacific Gas & Electric. General Electric is responsible for the operation of the reactor, of all the equipment in the reactor enclosure, and for a few items of equipment in the turbine building, including particularly the condensate purification system. Pacific Gas & Electric is responsible for the operation of the turbine, the cooling tower, and most of the equipment in the turbine building. The excellent co-operation between personnel of both organizations has resulted in smooth operation. The General Electric operating unit is directed by a manager of VBWR operation, who receives technical assistance from a technical operations unit and a physicist in the reactor operations organization of the laboratory. His organization includes an operations analyst, a reactor plant engineer, four shift foremen, and a number of operators. The Pacific Gas & Electric organization includes a station superintendent, a relief foreman, five shift foremen, and five operators. No technical personnel are directly assigned to the plant. However, technical assistance is obtained from two engineers attached, on a part-time basis, to the plant. These engineers average approximately 3 days a week at the plant. It should be noted that the organization described is not necessarily representative of that required for a full-scale commercial plant. Since this is a small research installation, the force is set up principally to fulfill the training requirement and handle the research program.

The Pacific Gas & Electric shift foremen and General Electric shift foremen are responsible for the areas of the plant described and for the performance of their respective company personnel. In addition, the General Electric shift foreman is responsible for the phases of steam plant operation which affect his section of the plant. This authority includes such matters as deciding when the reactor, and hence the plant, shall be operated or shut down, when steam may be given to the steam plant, the return of condensate to the reactor, and the over-all operation schedule. Clearances and maintenance procedures have been set up so that the



General view of upper level of turbine building, from the walkway leading to the control room. This photograph was taken during installation, before lagging was complete.

responsibility is properly placed on either or both of the shift foremen. A typical shift operating crew includes the two foremen, two General Electric operators, and one Pacific Gas & Electric operator. In addition to these personnel, one or more people are frequently attached to the shift crew for training purposes. It is felt, however, that the crew described is adequate for normal plant operation. The fuel-handling work is done by the normal General Electric crew as is the routine maintenance of the reactor. Routine maintenance of the turbine part of the plant is performed by Pacific Gas & Electric. The shop and maintenance facilities of the laboratory as well as outside service organizations are available as needed. It is interesting to note that personnel with experience in conventional power plants are able to operate and understand the reactor section of the plant with only a short period of training.

RADIATION

RADIATION LEVELS in the turbine and reactor building operating areas have not presented any appreciable problem to date. A few statistics on radiation exposure may be of interest. The total exposure, as indicated by film badges, for all personnel associated with the plant from the start of the first critical experiments in July 1957 until August 24, 1958, was 7,760 mr (milliroentgens). This exposure, which was distributed over an average of 35 people, is less than half of the maximum allowable exposure for one person. The average exposure during this period was 222 mr and the most any individual received was 390 mr. Only six individuals were exposed at a rate of 300 mr or more per year. Incidentally, 300 mr is the allowable dose for one week.

Maintenance work has been performed on the turbine, generator, exciter, feed pump, and steam and condensate piping. Radiation levels have been sufficiently low to permit working a full shift using normal procedures. Turbine work has consisted of removing the high-pressure casing, inspection of the turbine rotor and diaphragms, and temporary repairs to the high-pressure steam-seal packing. The principal radioactivities encountered were from stainless-steel corrosion products. They were found to be deposited, for the most part, in areas of the turbine, piping, and fittings where velocities are low. These deposits did not contribute, to any significant degree, to the over-all radiation level.

Maintenance work on the reactor has proved to be relatively simple. During the last four months the reactor has been opened 13 times to install, remove, or rearrange fuel as part of the experimental program. In one of these instances, less than 24 hours elapsed from the time the turbine was separated from the system until it was again paralleled. In view of the fact that a 540 F system must be cooled to a temperature at which we can work on it, and then heated again, we believe that this demonstrates the ease and simplicity of refueling. Radiation exposures have not been any problem in working on or around the reactor, although such precautions as wearing masks have been necessary when cutting into piping in the reactor system. Some troubles with the recirculating pump, which is directly exposed to hot water from the reactor, required the return of internal parts of the pump to the manufacturer. It was possible to decontaminate most of the parts to the requisite degree in only a few hours. Methods have been devised for replacing the deionizer resins while the plant is in operation with essentially no personnel exposure. Considerable ingenuity has been exhibited by operating personnel in devising special tools and handling equipment to speed their jobs. It has often been possible to build this equipment quickly and inexpensively at the job site.

Normal radiation protection has been sufficient for all work thus far. It is important, however, that allowance be made in estimating the length of outages for such things as the following:

1. Equipment must be decontaminated if it is to be removed from the site. In this case, consideration must be given to Federal and State regulations governing the shipping and handling of radioactive material.

2. Radioactive items must be stored in a manner which will prevent the spread of contamination to unrestricted areas.

3. Surveys must be made to determine the amount of radiation present and set time limits, if necessary.

4. Smoking provisions must be made for the maintenance people, since smoking or eating is not allowed in a radioactive materials area.

5. Extra time must be allowed for personnel clean-up at lunch time and at the end of a work day. This clean-up consists primarily of changing clothes and a survey.

6. Time is required for area preparation and clean-up. Time spent in properly preparing the area is more than saved by decreased clean-up time at the end of the job.

7. The obstacles encountered while working, such as wearing of gloves while working on small parts, wearing a fresh-air mask when grinding, welding or buffing, and so on, all slow down the general work pace.

On an over-all basis, the amount of extra time to be allowed for work performance will vary from 10 to 25 per cent.

The experimental program at VBWR has been quite varied and is becoming continuously more so. A large part of the effort to date has been directed to fuel-element tests. The VBWR is an excellent instrument for testing fuel under the particular environmental conditions which exist there and, for those conditions, is in many ways more useful than a loop in a test reactor. A large number of prototype elements for the Dresden plant were tested under somewhat more severe conditions than the anticipated operating conditions. Most of these elements included minor changes from the nominal prototype design in order to determine

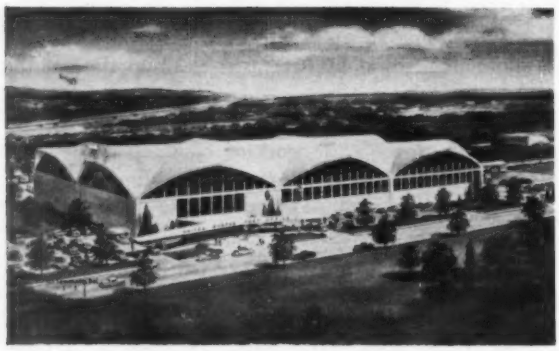
the effect of these small changes. At the present time, a number of similar elements are installed for a long-term evaluation of their performance at nominal design conditions. A number of different types of developmental elements designed either by General Electric or by customers without their own testing facilities are also being irradiated at the present time.

In addition to fuel tests, a number of experiments have been performed or are planned in order to increase knowledge of the operation of this plant or of other boiling water plants. This includes such things as studies of forced circulation and dual-cycle operation, evaluation of in-core monitors and rupture detectors, determination of stability limitations, studies of coolant chemistry and corrosion effects, studies of the dynamics of boiling, and evaluation of decontamination methods. The procedures for some of these experiments are not straightforward and interpretation of some of the results is difficult, but much useful information is beginning to accumulate. It is interesting to note that there have been relatively few conflicts between experiments.

One recent event of interest is a case of a fuel element rupture which occurred early in September 1958. Following a major loading change, unusual amounts of radioactivity were detected in various parts of the system about an hour after normal operating power was reached. The activity was sufficient to shut down the reactor by means of the stack gas activity trip. Since it was considered possible that the activity was caused by very small quantities of uranium on the outside of the one new element in the core, and since the activity decayed rapidly, a second attempt to start the plant was made a number of hours later. The reactor was again shut down by high activity and the suspect element was then removed. Operation thereafter was normal in all respects. Subsequent examination of the element revealed a defect which explains the observations. Gamma radiation measurements outside the turbine casing were about 10 times normal during the first of the runs. This decayed with an initial half-life of about an hour and a half. No steam was admitted to the turbine during the second start-up attempt. Twenty-four hours after the initial measurement, the activity was down to a value that was considered normal for the turbine during shutdown. Beta activity could not be measured because of the shielding provided by the turbine casing.

We feel that the operation of the plant, to date, has been very satisfactory and that we have found answers to a number of the questions posed by our experimental programs. We have learned many things about the operation of a boiling reactor and have accumulated valuable operation experience on a nuclear power plant. In so doing, we have trained and licensed over 40 operators, 13 of whom were Pacific Gas & Electric personnel, for the nuclear plants of the future. We still have much to learn.

Mechanized Post Office



Postmaster General A. E. Summerfield recently ordered construction of the nation's first fully mechanized mail-processing plant and post office at Providence, R. I. Intelex Systems, Inc., of New York, N.Y., a subsidiary of International Telephone and Telegraph Corporation (ITT), will build and equip this "post office of tomorrow" at an estimated cost of $20 million and lease it to the Post Office Department for 20 years. It will have 132,300 square feet of interior space, will be of single-story construction, and will have only two supporting columns. This will help eliminate the clutter and congestion typical of old-fashioned post offices and will provide easier, more efficient handling of mail.

Adjacent to the main post office building will be a heliport with 8,000 square feet of landing area, and a separate lubritorium building with 6,000 square feet of interior space. Also, there will be extensive driveways and parking and maneuvering areas.

The entire project is scheduled for completion in September 1960. Besides handling all the functions of a conventional postal installation, it will serve as a laboratory for highly advanced experimentation in mail handling methods and systems. Cost tests will be run to determine the efficiency and possible savings through use of various types of mechanical equipment.

Operations will be supervised from an elevated control room, serving as a nerve center, which will have a visual and an electronic view of all activities, and will control synchronized conveyor movements of mail in and out of the facility. Devices will "cull" letters from larger pieces of mail and "face" letters in a proper position to be canceled at high speed.

New Perspectives of Professional Responsibility

C. H. LINDER

FELLOW AIEE

THE WORD "perspective" implies a whole view, complete in all its dimensions and in correct relation to its background. I want to sketch such a view of engineering today, with special attention to some new dimensions of professional responsibility. Going back a bit in history, we can start by separating the threads of science and engineering which are so closely interwoven in the fabric of modern civilization. In this way, we can identify those characteristics which are predominant in the work of engineers.

SCIENCE STANDS ALONE

SCIENCE STARTED with the observations, conjectures, and experiments of the philosophers. Thus it began in some isolation from the world of everyday men; and down through the years into the present it has maintained two distinguishing characteristics. First, the choice of what scientists work on is motivated by their own intellectual curiosity. Many of the early philosopher–scientists might be said to have wandered about among a variety of subjects which today would represent a span of specialized fields impossible for one man to encompass, so great and complex have the total funds of scientific information grown. Yet still today, even when highly organized scientific investigations must be conducted in very specific fields, I am sure directors of research would agree that one does not start with any scientist and ask him to take on your problem. Instead, you approach the scientist who is, or wants to be, an outstanding expert in the field in which the problem lies.

Second, the primary objective of the scientist's work is new understanding and knowledge of the natural world and the universe, rather than devices or services which people use. I say "primary objective" because, of course, many scientists have been interested in, and have suggested, applications of their discoveries. But, by and large, what we call the scientific turn of mind tends to press on for more understanding and knowledge, leaving application to others. In point of fact, application has often languished for centuries. I imagine many of you have seen the classic example described in a recent Bell Telephone advertisement, which points out that 77 years elapsed between Galileo's observation of the pendulum's behavior and Huygen's invention of the pendulum clock—even though Galileo himself suggested the application!

OBJECTIVES AND APPLICATIONS

IT IS THIS MATTER of application which brings the sharply contrasting work of engineering into the picture. Engineering is dominated by an intellectual urge to take scientific principles, derive from them the necessary technologies, and put science and technology to work doing something new or better for the comfort or convenience of people. Useful products and services are its primary objectives. As you are well aware, it is engineering which has shifted the load of physical drudgery from men and animals to machines. Engineering has extended man's influence over his physical environment so that he can move about more swiftly and freely, communicate instantaneously over great distances, measure and control quantities and forces both enormously greater and infinitely smaller than he is. Engineering has provided the extraordinary array of devices available for man's physical well-being. Right now engineering is swiftly extending man's capacity to do mental work of all kinds, by means of machines able to perform complex logical operations which only the human brain could do before.

Small wonder, then, that science and engineering are dominant in our civilization or that they promise

Revised text of Recognition Dinner address of the Eta Kappa Nu Association, New York, N. Y., Feb. 2, 1959.

C. H. Linder, AIEE Treasurer and Chairman of the Eta Kappa Nu Jury of Award, is with the General Electric Company, New York, N. Y.

to become more so, not less. At the beginning of this century, to speak in approximate terms, two tremendously significant things happened. The discoveries were made which opened up the fields of subatomic studies—that is, of structures and forces within, and smaller than, the atom. Also at about this time, there came into being in industry, and elsewhere, the idea of organized technical effort. For the first time, facilities and competence were deliberately marshalled to make discoveries and to shrink the time-lag between discovery and application.

WORLD-WIDE CHANGES

THE WORLD has indeed not been the same since. From that time on, growth and change in the great funds of scientific and technological information have been accelerating sharply, with the years during and since World War II producing an astonishing snowball effect. In the same period of time, products and services—engineered from those same funds of information—have multiplied over and over again, and have raised the living standards of millions of people, particularly in the United States.

This is the background against which the engineering profession stands. Now, leaving the past for the present and the future, what are some of the new facets of our responsibilities today?

Certainly, there is a sharpened need for better management of engineering work. By "better management" I mean making more effective use of the resources of time, money, facilities, and competence placed at the disposal of engineers. Today, the lockup of these resources in even a single engineering project can easily constitute a major risk to a business—or to a nation, for that matter. To this point, we as engineers should remember that starting or carrying on engineering work with only a successful technical result in mind is taking a grave chance of winning the battle and losing the war. We must keep our attention fixed also on the over-all objectives into which the successful technical result we seek must fit, if we are to contribute a successful part to a successful whole.

NEW POSSIBILITIES

THIS WORKING CLIMATE of exceedingly great and rapid technological change can have a strong effect on the management of our work. If we do not vigorously cultivate alertness and perception we may wake up to find that we are dissipating effort and resources on an engineering approach which change has rendered unrewarding—perhaps literally overnight. The other side of the coin is that technical change brings out so many fascinating new possibilities, so many promising approaches, that we are eager to try them all. But our resources are not unlimited, and we must therefore develop immunity to the virus of "technology-for-its-own-sake." Very delicate balance is required here, so that we do not neglect the new and promising in favor of the tried and true. This balance can be achieved, I believe, by cultivating the habit of regularly reviewing work in progress. Thus, projects showing signs of poor pay-off can be weeded out. Multiple approaches to the same end result can be minimized, and the most promising fixed upon early in the game.

Another key facet of engineering responsibility is to work ably as members of a team. From the technical aspect, this has to be, because the range of disciplines which are required to achieve really significant progress can often come only from several people. And there is much more than that involved. We noted in discussing the need to manage our work better, that engineering requires heavy investments of resources and that it must understand and be guided by the over-all objectives as well as by the technical. This means that engineers must rely on much work by others to provide the resources they use. It also means that engineers need to be aware of and sympathetic to the many implications from other fields of expertness which go to make up over-all objectives.

THE DILEMMA OF CREATIVITY

NOW, IF YOU BELIEVE as I do about the nature of engineering work, this can appear at first glance to put the engineer in something of a dilemma. The heart of the engineer's work is a creative synthesis. He draws from his understanding and knowledge of science and technology certain specific items; and then, by an intensely personal process of his own mind, puts them together to form a new engineering design. In other words, he "has an idea"; and how can such a personal process be compatible with group effort? The answer, I think, is simple to state, although difficult to accomplish. The engineer must be able to create in many dimensions; that is, his synthesis must integrate with the work of other people in many fields of expertness—including, but by no means limited to, the physical sciences. He is responsible for, and can take pride in, a personal "idea factory," so to speak, which is able to accept all sorts of raw materials and process them into a successful design.

Indeed, when some of the economic and social factors which the engineer must increasingly take into account are considered, it is scarcely an exaggeration to say that his teamwork responsibilities are global in extent and impact. Think for a moment how the work of engineers is woven through some of the great social and political problems we face. The current skirmishes of the satellites are a prominent example, but there are many others which represent even more basic involvements. We noted earlier, as part of the background against which our profession stands, that the United States has given the world a brilliant illustration of applying sciences and technology to produce a steadily rising standard of living. The world has learned its lesson well. Permeating the spirit of nationalism which today is sharpening everywhere is the determination of each country to spread the social and

economic benefits of material progress among its people. Their interests include everything from water supply and electric power to motor-scooters and bobby-pins. The European Common Market is an organized effort to extend European industrial success broadly, as in the United States, by creating the kind of broad, free markets which are essential to mass distribution of goods. Other nations such as the Soviet Union, China, India, and the countries of Africa and South America—which already have great potential markets and untapped resources—are stirring and reaching toward industrial and engineering development. In fact, we had better realize that the USSR began to stir a long time ago, and is now, at least in her own opinion, within reach of her goal—equality with the United States.

Let us note, too, that the rising pitch of interest in the benefits of engineering and industrialization is intensifying world competition, both for raw materials and for markets in which to sell manufactured products. Our Nation is already a heavy importer of raw materials. We need, as Mr. Percy Bidwell noted in the October 1958 issue of *Foreign Affairs,* 35 to 40% of the free world's supply of basic materials to keep our factories going. How we will keep them going at expanding rates is a good question.

POTENTIAL SOCIAL EFFECTS

FINALLY, to round out the picture, we should not neglect the potential effects throughout society of particular major achievements of science and engineering as they occur. Space travel leaps to the mind as an example, of course; but we need not go interplanetary distances to find others. Computers are an excellent case in point, with their capacity for radically altering our existing institutions and organizations. Although a good deal of what we have heard about automation and the "push-button" factory has been more dramatic than practical, the computing machine—coupled with factory mechanization techniques and engineering techniques of designing for automation—will have great impact on the lives of all of us, and soon. The computer's phenomenal ability to accomplish quickly very complex processes involving large quantities of information has already led, for example, to a practical system of guided missiles for defense. Human lives need no longer be risked to provide judgment and control for the dangerous job of piloting combat aircraft on missions against an enemy. The same potential inherent in computers is bound to affect how we plan and organize activities in many fields. This will not eliminate human effort, but rechannel it to tasks for which it is uniquely required. One more instance of this type of particular achievement deserves mention, if only briefly. Nuclear power promises to contribute greatly to worldwide social and industrial change, for it can make—in fact it is already making—electric power available in quantities to nations whose natural fuel resources have, up to now, limited their capacity to industrialize.

Thus, the implications of engineering work are plain in many social, economic, and political areas. The moral, I think, is this: As engineers, we are coauthors of many problems which our Nation and all nations must solve, both at home and abroad. As engineers and citizens, we are co-recipients of those problems. Therefore, we must be sensitive to the effects of our work before the fact; and concerned and helpful after the fact, in the process of adjustment. This is why I included the elements I did in my perspective sketch of the stature which must be attained today by any professional who calls himself an engineer, or by any engineer who thinks of himself as professional. This is why he must maintain expert competence in his technical fields of interest; this is why beyond that, he must be able to perceive and weigh a large variety and number of factors in his creative process. This is why he must be effective as a member of a team; his team profoundly affects society—including himself.

80-Ton Conduit Installed

Byers Photo

Placing an 80-ton conduit unit in a trenched area under the Harlem River at the 225th St. side of New York City's new Broadway Bridge required use of electrical conduit capable of resisting many years of severe corrosive attack. Durability was given top priority.

The two-level bridge—a new vertical lift span for vehicle and elevated subway traffic—is being supervised by the New York City Department of Public Works.

The 316-foot-long conduit unit, using special split sleeve couplings, was assembled on the deck of a 327-foot-long scow and then lowered by four closely co-ordinated cranes. It took less than 3 hours to lower the unit into the underwater trench. A row of five 6-inch diameter conduits was positioned on top of five 8-inch diameter conduits. The conduits—with 90-degree bends at each end—were banded together by Jandous Electric Company prior to placement by Moore & Lopier of New York City. Byers 4-D wrought iron conduit was used because of its mechanical strength and resistance to corrosion, shock, and fatigue.

Electric Breakdown of SF_6 in Nonuniform Fields

D. BERG

C. N. WORKS
MEMBER AIEE

SEVERAL INVESTIGATORS have shown that in a nonuniform field the positive direct breakdown voltage versus pressure characteristic of sulfur hexafluoride (SF_6) exhibits a very pronounced maximum. Pure nitrogen (N_2) does not show such a maximum. This unexpected performance is best illustrated by Fig. 1. Although the positive direct breakdown voltage goes through a maximum, the positive impulse breakdown voltage is much lower over a considerable pressure range. This produces an impulse ratio as low as one half. At the same time, the positive direct voltage required for breakdown may be as high as six times that for nitrogen. In the region of this maximum, corona occurs at a voltage much lower than breakdown. The 60-cycle crest breakdown voltage practically coincides with the positive direct breakdown voltage.

These two characteristics, an impulse ratio less than one and a maximum in curve 1 (Fig. 1) are peculiar to electron-attaching gases. Although little direct quantitative evidence of the effect of corona on breakdown values has been disclosed heretofore, the term "corona stabilization of breakdown" has been applied to this anomalous behavior. The purpose of this article is to show that corona occurring around the point produced the unexpectedly high direct-voltage breakdown values shown in Fig. 1. To obtain this objective, a positive direct voltage was applied to the point, as a bias voltage, and a positive $1\frac{1}{2} \times 40$ microsecond impulse voltage was superimposed on this bias voltage.

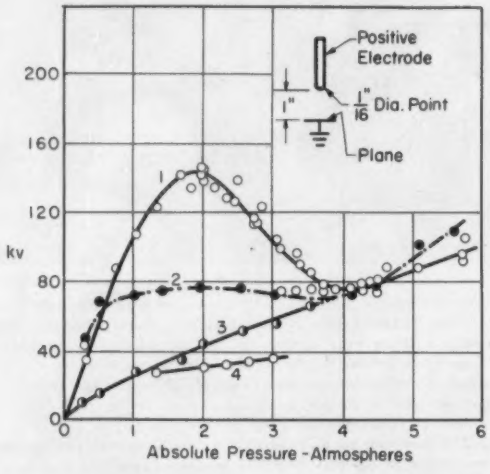


Fig. 1. Breakdown and corona onset voltages vs pressure at 25 C in a 12-inch steel tank. Curve 1 (SF_6), positive direct voltage breakdown; curve 2 (SF_6), positive impulse voltage breakdown; curve 3 (SF_6), positive direct voltage corona onset; curve 4 (N_2), positive direct voltage breakdown.

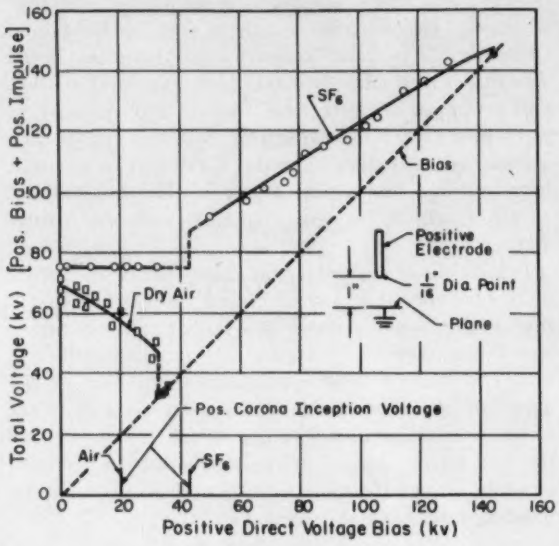


Fig. 2. Total breakdown voltage vs positive direct voltage bias at 2 atmospheres absolute pressure and 25 C.

The results obtained at 2 atmospheres pressure are shown in Fig. 2. For SF_6, the total voltage for breakdown remains constant up to the corona-starting voltage (43 kv), after which the total voltage increases with direct voltage bias. Thus, the space charge effect increases with direct bias voltage above the corona starting voltage.

For air, at 2 atmospheres, the results are quite different (Fig. 2). Both above and below the corona-starting voltage, the total voltage for breakdown decreases with increasing bias. The impulse breakdown voltage is about twice the direct voltage value. An impulse ratio greater than one is normal for most gases.

Returning to the case of SF_6, it has been shown that above the corona-starting voltage, space charge causes the total voltage for breakdown to increase as the bias voltage increases. Below the corona starting voltage, the total voltage vs bias voltage characteristic is flat.

This shows that when corona occurs before breakdown, the presence of corona raises the breakdown value to produce the maximum in the positive direct voltage breakdown (and also 60-cycle voltage) vs pressure curve as shown by Fig. 1.

Digest of paper 57-242, "The Effect of Space-Charge on the Electric Breakdown of Sulfur Hexafluoride in Nonuniform Fields," recommended by the AIEE Dielectrics Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Summer General Meeting and Air Transportation Conference, Buffalo, N. Y. June 22-27, 1958. Published in AIEE *Power Apparatus and Systems*, Oct. 1958.

Daniel Berg and C. N. Works are with the Westinghouse Research Laboratories, Pittsburgh, Pa.

Applying Zener Diodes to Expanded-Scale Instruments

A. J. CORSON
MEMBER AIEE

ONE INTERESTING RESULT of the application of information theory to electrical measurements is that design practice should change in some particulars to keep pace with application needs. This applies with particular force to the span of measurement which, in many instances, is some normal value plus or minus the expected variations in the voltage, current or power in the circuit. In contrast to this need, the span of most electric instruments traditionally starts at zero and extends to some value in excess of the anticipated maximum. The accuracy and visual resolution of measurement may be increased by scale designs which transfer the little-used lower portions of the scale range to the estimated range of operating values.

There are two general methods of attacking this problem, namely, (1) the redesign of instrument mechanisms for limited span and (2) the use of conventional zero-left mechanisms with an interposed impedor, the admittance characteristic of which contours the scale distribution to the desired result. Of the two methods, the impedor is preferred because of its greater flexibility and because it preserves standardization of the instrument mechanism.

Circuit components are now available which make such impedors practicable, compact, and accurate. By use of any one of several circuit configurations, using Zener diodes as a reference voltage to block off the unwanted portion of the measurement range, spans of ± 8 per cent and lower can readily be obtained with substantial gains in both visual and inherent accuracy.

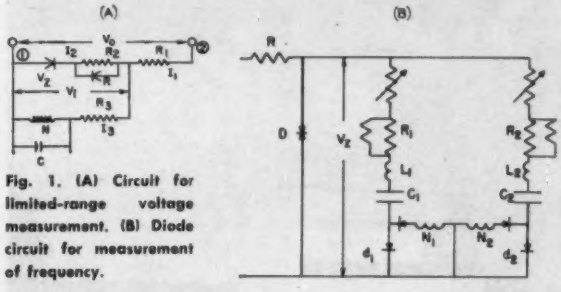


Fig. 1. (A) Circuit for limited-range voltage measurement. (B) Diode circuit for measurement of frequency.

Circuits have been developed for the short-range measurement of a-c voltage and frequency using d-c instruments as indicators, as shown in Fig. 1. In the circuit for voltage measurement, the d-c instrument compares the average *IR* drop in a fixed resistor on the positive half cycle to the Zener voltage on the negative half cycle and measures the difference. This *IR* drop is proportional to line voltage, whereas the Zener voltage is constant. It follows that the output has a d-c component proportional to the difference between the reference and applied voltages. This results in a scale distribution which is substantially linear, as shown in Fig. 2.

The circuit is relatively insensitive to frequency change, has a temperature coefficient of about 0.05 per cent per degree centigrade and responds well to temperature compensation. Its waveform error is less than a third that of a conventional rectifier instrument for 10 per cent third harmonic, because of the effect of this harmonic on the average Zener voltage.

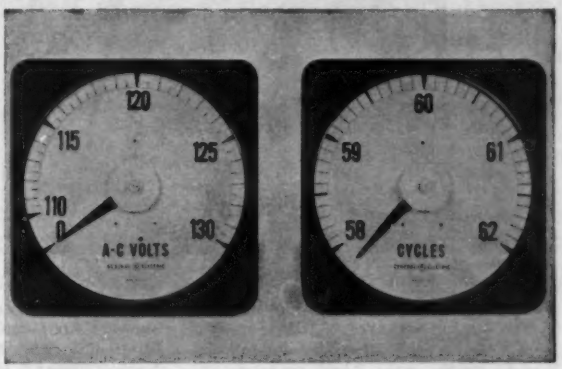


Fig. 2. Switchboard instruments for limited-range measurement of voltage and frequency using Zener diodes.

The use of Zener diodes in frequency meters results in substantial gains in accuracy and sensitivity. As shown in Fig. 1, the full-wave diode stabilizes the voltage which is then applied to the conventional parallel resonant circuit. A differential d-c half-wave milliammeter compares the currents in the two circuits and measures the difference, which is proportional to the departure of the frequency under measurement from the reference value. By use of silicon diodes, mica capacitors, and temperature compensation, very good temperature and time stability are achieved. Waveform errors are minimized by the circumstance that the incoming voltage wave is clipped and filtered by the action of the circuit. Volt-ampere consumption is approximately 40% of the maximum value permitted by American Standards Association specifications, and the instrument is about twice as responsive as required.

Digest of paper 58-934, recommended by the AIEE Indicating and Integrating Instruments Committee and approved by the AIEE Technical Operations Department for presentation at the AIEE Summer General Meeting and Air Transportation Conference, Buffalo, N. Y., June 22-27, 1958. Published in AIEE *Communication and Electronics*, Sept. 1958, pp. 535-39.

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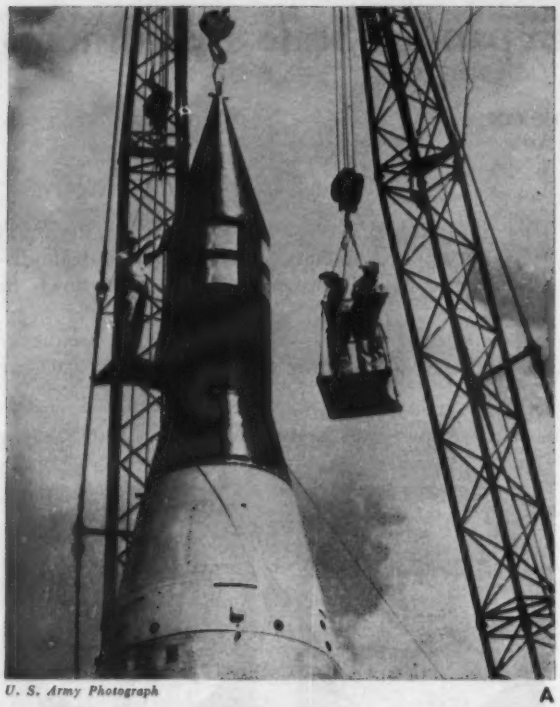
Pictorial Review

International Geophysical Year Activities Continue



U. S. Army Photograph

A

SOME of the activities of the International Geophysical Year (IGY), as reflected in the program carried out by the United States, have been reported as they occurred throughout the official 18-month period in which the IGY scientific community made its reports to the U.S. National Academy of Sciences. The magnitude of the world-wide effort can be visualized when one sees a listing of the number of principal stations in each activity classified by latitude zone and degree of geographical coverage.

The total number (eliminating those duplications where projects in two or more fields were housed together) was 2,461. The number of projects, or station activities, totaled more than 3,500, or some 4,000 or more counting contemporary and volunteer sites or stations.

It is virtually impossible to take a count of the individuals actively participating in the various national committees, funded programs, and extensive voluntary public and private contributions. Three aspects of the IGY program can be summarized as: (1) the discoveries and interpreted results, (2) the all-inclusive effort that gathered the vast quantity of data, and (3) the direct impact the program will have on any future geophysical programs.

The earth satellite, Juno II, is seen being assembled in the field (*A*) for use in the U.S. IGY space probe program. The heat-protecting shroud that is covering the upper stages was designed to protect them from the extremes encountered in the lower atmosphere. The vehicle shown launched the space probe Pioneer III at 12:45 a.m. on December 6, 1958, from Cape Canaveral, Fla. The Pioneer III launching was accomplished under the management direction of the National Aeronautics and Space Administration by the Army Ballistic Missile Agency and the Jet Propulsion Laboratory at the California Institute of Technology.

The section of the "CSAGI Guide" outlining the operation of the data centers for rockets and satellites was issued in April 1958 and revised at the 5th CSAGI Assembly in Moscow, USRR, in August 1958. At present, data have been received

National Academy of Sciences–IGY Photo

B

from Argentina, Canada, Denmark, France, Germany, Japan, South Africa, the United Kingdom, the United States, and the USSR. Because of the nature of rocket and satellite data, the agreed-upon time table allows 12 months after completion of an experiment before published results are expected. In order to keep the scientific public informed during this period, World Data Center A (for rockets and satellites) initiated two series of reports containing interim and preliminary observations and results. To date, reports No. 1 through No. 6 of the "WDC-A Satellite Report Series" and No. 1 of the "Rocket Report Series" have been issued.

In the meteorological investigations, new emphasis on upper-air weather soundings raised the average of balloon altitudes from about 71,000 to 83,000 (for 600 gram balloons) and to 90,000 feet (for 800 gram balloons), permitting the first routine preparation of stratosphere circulation studies at the 10-millibar level.

Weather instruments and transmitters were carried to 100,000 feet with new types of balloons (***B***). IGY observers obtained information on nuclear debris and weather conditions at that altitude. This new data will soon be used by rocket planes. The instruments and transmitter are housed in the small box held by U.S. Weather Bureau observer.

Aurora and airglow studies were made extensively and at various stations. One of these was the IGY radiotelescope (***C***) at Cornell University, Ithaca, N.Y. Equatorially mounted, the 17-foot parabola originally was the antenna from an *SK-2* U.S. Navy radar set. In addition to its declination and hour-angle motions, it may also be rotated on a vertical axis. Originally intended and used for galactic and extragalactic work, it has since been used for solar observations and is now being used in measuring the polarized components of solar radiation. Adjusting the manual declination position is one of the research associates at the School of Electrical Engineering. Visual observations have been made at Cornell University.

The number of these stations from which data are expected total more than 1,650 throughout the world. Solar activity was carefully recorded at points around the world, on "world days" when observations were made simultaneously.

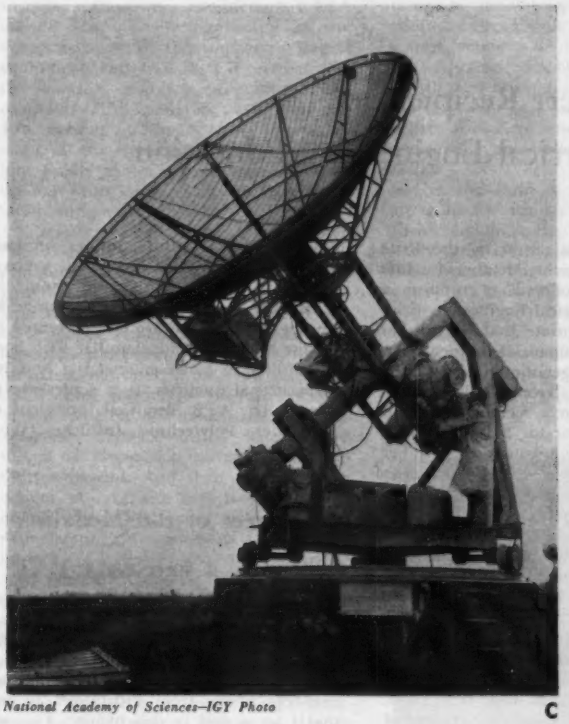
A "forest" of six Nike-Asp rockets are pictured (***D***) being erected on the deck of the U.S. Navy ship *USS Point Defiance (LSD 31)*, anchored off the South Pacific Island of Puka Puka.

In the first use of high-altitude rockets for astrophysical eclipse measurements, five were launched within a span of 40 minutes, and two were in the air simultaneously during the total eclipse. The rockets assisted a team of Naval Research Laboratory and other IGY scientists in making IGY radiation studies of the sun during the eclipse which occurred on October 12. Telemetering time averaged close to 8 minutes per rocket. A sixth rocket was fired on October 13, when a solar flare occurred following the eclipse.

The Nike-Asp rocket carried radiation-measuring instruments to an altitude of 140 to 150 miles, exceeding all previous shipboard attempts. The team under the direction of H. Friedman discovered that in the lower-D region of the ionosphere, X radiation created an increased ionization during solar flare which cause the blackouts of radio communications. It was also reported by this team that X rays increase when there is solar flare activity, whereas ultraviolet rays do not increase.

In the same series of investigations, it was noted that during total eclipse X rays were detected but that there was a complete absence of ultraviolet radiation. It was the first time that rockets had been used in such studies, and in addition to supplying more information about the upper atmosphere and solar processes, it will shed greater light on radio propagation problems.

The formal ending of the IGY on December 31, 1958, did not terminate the international co-operation in geophysical studies. During the 5th Assembly, it was stipulated that studies and co-operation along the same lines would be continued by all participating nations throughout 1959. An internationally co-ordinated continuance will carry on such studies as appear practicable under the auspices of the International Council of Scientific Unions. The council-authorized Special Committee for Inter-Union Co-operation in Geophysics (SCG) will assume the responsibilities formerly handled by the CSAGI of the IGY. Thus, special committees set up by the council will gather information as indicated and needed. Committees already have been set up to continue the studies in oceanography, the Antarctic, and space science.



National Academy of Sciences–IGY Photo

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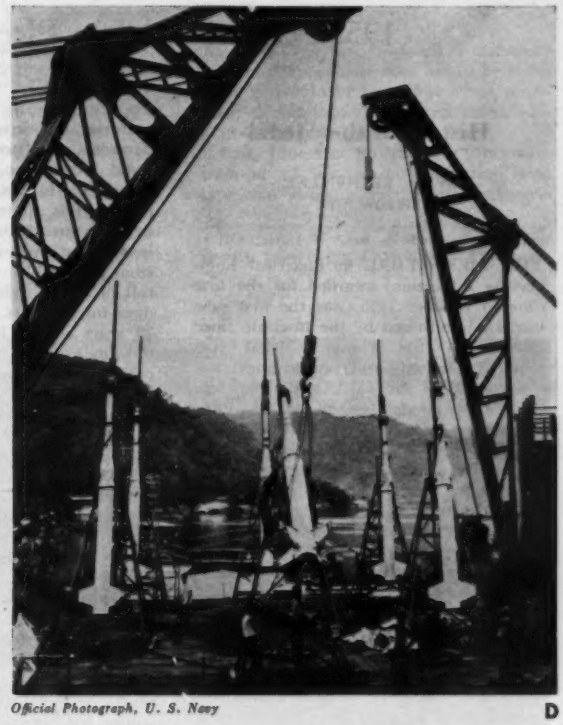

Official Photograph, U. S. Navy

D

ELECTRICAL ENGINEERING EDUCATION

"The award will be made to a teacher of electrical engineering based upon his teaching experience, his ability to inspire students to higher achievements and capability, contributions to the teaching of electrical engineering in text books and in writings on engineering education, active participation in the work of the professional and educational societies, and contributions to teaching and the profession through research, engineering achievements, and technical papers."

John F. Calvert Recipient of 1958 AIEE Medal in Electrical Engineering Education

History of the Medal

W. R. BROWNLEE
FELLOW AIEE

THE AIEE MEDAL in Electrical Engineering Education, awarded for the first time in October 1956, was the first new medal administered by the Institute since 1928 when the Lamme Medal was founded. The only other medal under the sole control of the AIEE until then was the Edison Medal, established in 1909. Following the upsurge of AIEE technical activities in the wake of the Ashville Resolution, officers of the Institute became increasingly aware that channels for the recognition of engineering achievements had lagged far behind both the growth of Institute membership and the number of achievements worthy of professional recognition. In early 1954, former President E. B. Robertson challenged the Technical Committees to determine what areas should be honored and to seek new channels of recognition. After an exhaustive study, the Prize Awards Committee recommended and the Board approved a plan for the creation of several new awards. Two results are the Morris E. Leeds Award in Instrumentation and the William M. Habershaw Medal in Transmission and Distribution, which were described in the February 1959 issue of *Electrical Engineering*, p. 179. Two additional awards are now under consideration.

During the investigation by the Prize Awards Committee, the Members-for-Life Fund Committee offered to support a new Medal in Electrical Engineering Education. It is appropriate that recognition in a field in which financial compensation is traditionally meager should be financed from funds given "above and beyond the call of duty." When a member has paid dues for 35 years, or for 30 years and is 70 years of age, he becomes a "Member for Life" and is relieved of further dues obligations. Many have chosen to continue to pay the equivalent of dues as a token of appreciation of the meaning of the profession and the AIEE in their lives, thus supplying a tangible example of the late Dr. Wickendon's engineering analysis of "the second mile." Prof. K. L. Wildes and his Members-for-Life Fund Committee are charged with the administration of this income. These funds, together with income from investments made from them, are being used for a surprising number of good causes within the Institute. The magic of punched cards, magnetic tapes, and data programs able to create other data programs have been unable to resolve that mysterious factor which multiplies the benefits of gifts freely given. Part of the specifications for a man to be honored are:

> "The award will be made to a teacher of electrical engineering based upon his teaching experience, his ability to inspire students to higher achievements and capability, contributions to the teaching of electrical engineering in text books and in writings on engineering education, active participation in the work of the professional and educational societies, and contributions to teaching and the profession through research, engineering achievements, and technical papers."

The Recognition Awards Committee is proud that a large number of outstanding teachers have been nominated for this medal by the colleges themselves, by officers of the Institute, former students, and AIEE committees. From these we have selected Dr. John F. Calvert from the University of Pittsburgh as the most deserving. Our reasons are best presented by a close associate of his, familiar with both his ability to teach engineering and his inspirational qualities. It is a pleasure to present Dr. A. B. Bronwell, president of Worcester Polytechnic Institute, Worcester, Mass.

Career of the Medalist

A. B. BRONWELL
MEMBER AIEE

GREATNESS often comes in humble packages. A week ago the friendly voice of today's award recipient came to me over the phone from Pittsburgh, urging that I be modest in this tribute. This set off a chain of questions in my mind—what is greatness?

Perhaps one who has worked with hundreds upon hundreds of students, helping them to solve life's problems, giving them visions of higher purposes in life, leading them into worthwhile goals, imparting to them the self-confidence and the finer qualities of character which starts them on the roads to successful lives, might in a quiet but certain way be achieving a true measure of greatness.

Perhaps one who draws within his sphere talented, young faculty members and, by giving full play to the forces of youth, with a liberal measure of encouragement and responsibility, lifts them to the highest levels of achievement, might himself in no small way be achieving greatness.

Presentation and acceptance addresses made at the ceremony for presentation of the AIEE Medal in Electrical Engineering Education held during the AIEE Winter General Meeting, New York, N. Y., Feb. 1-6, 1959.

W. R. Brownlee, Southern Services, Inc., Birmingham, Ala., is chairman of the Recognition Awards Committee.

Dr. A. B. Bronwell is president of Worcester Polytechnic Institute, Worcester, Mass.

If the criterion for greatness is not what one does for oneself but, rather, what he does for others; if it can be measured by all those who respect him for his own distinctive professional accomplishments: as well as by those whose lives he has influenced for the better and who revere him for his fine qualities of character, then all will acclaim our 1958 recipient as a man of true greatness and distinction.

John Calvert started life modestly enough as the son of a college professor. Some 19 years later he found himself on the battlefields of France dodging hand grenades and mortar shells. Four years after the war was concluded, he bade farewell to the campus of the University of Missouri and headed for the Westinghouse Electric and Manufacturing Company. Here he soon was recognized as a young man of very considerable talent, for he was given responsibility in the design of some of the company's largest equipment and was invited to teach in the evening graduate program of the company. His scholarly pursuit of his own evening graduate work in mathematics at the University of Pittsburgh led him finally to the Ph.D. degree, one of the first of its kind in the country granted for evening work.

I review, briefly, some of his work: the design of turbogenerators ranging in size from 600 kva to 205,000 kva; the design of equipment for the propulsion of large ocean-going ships; and also research on magnetic field distributions, on iron losses, on short-circuit forces, ventilation, insulaton, lightning protection, fractional slot winding magnetomotive forces, analog computers, economic models, loss minimization in electrical utility systems, and special new types of open- and closed-loop control systems. And then there are the designs of large-size high-frequency generators and of high-speed motors for propeller testing. These efforts keep a man busy.

In 1936, Dr. Calvert's yearning to enter academic life, with its freedom for professional development in his own chosen fields, took him to Iowa State College as associate professor of electrical engineering. Two years later he became chairman of the electrical engineering department at Northwestern University. Under the impetus of his dynamic energy, things began to happen in quick succession at Northwestern University. With a two-man electrical engineering department (including himself) he boldly launched an evening graduate study program leading to the master's degree. Then there were the none-too-modest jobs of recruiting a faculty, of extensive curricular revisions, and of helping to plan a new $4.5 million Technological Institute building, with all of its complexities of laboratories, equipment, classrooms, etc.

When World War II clouds rolled over Europe, Dr. Calvert accepted a temporary assignment with the Naval Ordnance Laboratory. This carried him to Hawaii for the installation of large-scale degaussing equipment to protect ships from magnetic mines. When the bombs fell on Pearl Harbor, Dr. Calvert was there.

When the job was completed at Hawaii, he returned to Northwestern University where he organized a large training program for Navy radio operators and assisted in organizing a Radio and Electronics School for the Army Signal Corps. Later, he established an Aerial Measurements Laboratory which, among other things, pioneered in the research and development of analog computers. Here, as I suggested earlier, he was ahead of his time, for the analog computer idea was still almost in its infancy. This was but one of the many research projects which he undertook personally or which he supervised.

Four years ago his Alma Mater, the University of Pittsburgh, invited him to return to its campus. Here, with his usual enthusiasm and dynamic energy, he started programs moving rapidly ahead in further developing industry–college relations, in developing new research and educational programs and in building up a new, young staff. Here, as everywhere, he has gained the highest admiration of all who are associated with him.

His 34 technical papers, numerous published discussions, his patents, papers on education, on research administration, booklets for student use, and much work left in the form of engineering reports, attest to his scholarly interests. In fact, when one finds Dr. Calvert, he is quite likely to be totally immersed with solving some frontier engineering problem or engaged in his favorite pastime of doodling with pencil portraitures of unsuspecting victims.

His various societies, 40 or more, local or national, are too numerous to mention in detail, but he is in demand everywhere. Always his quiet spoken opinion, adorned with a Missouri inflection and subtle humor, is highly respected.

Dr. Calvert, we congratulate you on this well-earned distinction. May I also add that this comes as a fitting tribute, not only to yourself, but to the one whom I am sure you will be the first to acknowledge as the source of your lifelong inspiration—your wife, Harriet Calvert.

Electrical Engineering Education

The Fifth Dimension

J. F. CALVERT
FELLOW AIEE

AS ALWAYS, Pres. Bronwell is unusually generous. To gainsay him would be rude; to agree would be immodest if not somewhat hypocritical. But, I can thank him and do so most sincerely.

Last June, in Buffalo, Mr. Brownlee told me of his committee's action, and late that evening I counted on fingers

J. F. Calvert is head of the electrical engineering department, University of Pittsburgh.

Courtesy Ross Photos

DR. J. F. CALVERT (*second from right*), head of the electrical engineering department at the University of Pittsburgh, receives the AIEE Medal in Electrical Engineering Education from AIEE President L. F. Hickernell (*second from left*). Observing the presentation are Dr. A. B. Bronwell, president of Worcester Polytechnic Institute (*left*), who described the career of the medalist, and W. R. Brownlee (*right*), chairman of the AIEE Recognition Awards Committee, who gave the history of the medal. The presentation took place during the Winter General Meeting of the Institute.

Electrical Engineering Education

and thumbs—several times around—colleagues whom I would have proposed and been pleased to vote for had I been a member of Mr. Brownlee's committee. This and further thought brings me here, I hope, in full knowledge of good fortune and profound appreciation of the confidence expressed by Mr. Brownlee and by his committee.

In considering what to say, I have reviewed in my mind the programs for the improvement of engineering education which have evolved since 1945, and how new ideas have become infused with the old. The aim has been to strengthen the scientific content of all engineering education yet to maintain good programs in the humanities, and the major emphasis has been on undergraduate study. This review led me to wonder about the trends to come. Should the outlook be broadened and what more might be needed to meet the oncoming responsibilities?

I have no points to drive home today, but only plan to review in a preliminary way what some of these trends might be.

In all recorded time, I thought, engineering has called for materials, for adequate power, and for distinctive and ingenious thought. And in the past, at least, it has been impelled by specific but rather contemporary human desire.

In thinking further, it seemed to me that for ordinary engineering there are three dimensions—and time is a separate thing, while for science these are four. But for all great endeavor there is a fifth dimension and this dimension is purpose. It is of engineering depth in this last direction that I decided to speak today.

However, travel in this direction takes me farther afield than I am normally accustomed to wander. It leads to a more speculative view. It suggests direction rather than structure. It implies a long backward look in order to estimate the forward line.

I think that we should start with the backward look and pick out views as we go that may suggest the route of engineering progress.

Engineering Before Newtonian Science[3]

Early engineering was qualitative "know how" rather than computative design, for science was mystic and substantially unapplied. Even so, who may question the technical competence of the engineering which entered into the tremendous constructions of ancient times? Most spectacular of these was the building of the pyramids. There, in Egypt, 4½ millenia ago stood masses comparable, in a way, to the Hoover Dam and to Grand Coulee. We observe architecture, alignment upon the earth accurate to 5 or 10 minutes of angle, and design with compressive loads on stone up to 400 or 500 pounds per square inch. This was engineering. Yet, in its final operating form there remained no bending, torsion, or dynamic problems and the pyramids stand forth as monuments.

In Greece, there has been uncovered evidence of a newer concept. From the grooves and rust in stone, it seems clear that designers had discovered the material value of iron strung along the lines of tensile stress. Still there is little evidence of high-level calculation in design.

Then, on the Iberian peninsula, the Romans, with auger-like devices, pumped water from their mines which they had dug 600 feet below the surface. This involved simple dynamics and power problems, but again, no high-level calculation. They did this work even though they chipped through stone by the then age-old method of heating and quenching.

The engineering plans of ancient times were developed with little scientific knowledge and consummated almost completely without inanimate physical power. Engineering was carried on to erect memorials, to win wars, and to produce wealth—all acceptable purposes. It has been said that ancient engineering suffered most from a lack of physical power. Perhaps it would be more accurate, however, to say that it suffered from an utter lack of recognition of the need for such power. Toward the end of this 3,000 year period, a small steam turbine was built and demonstrated, but not for engineering use. We cannot even say slavery was the alternative to physical power. Slavery was power.

A long jump to the 13th century shows something of a break with this past. Around 1200 to 1300 the revolution in power got off, if only to a faltering start, with the harnessing of the winds and small streams for the practical tasks of pumping and grinding. But it took the scientific discoveries that followed to produce marked changes in engineering.

Galileo and Newton
Science, Philosophy, and Engineering

Modern science, with its truly novel method of thought, emerged between 1400 and 1700, particularly toward the end of that period. Alfred North Whitehead pointed to the coincidence that the year 1642, in which Galileo died, was the year of Isaac Newton's birth. Whitehead writes of the period 1600 to 1700 as the "Century of Genius." Although relatively less was done for the life sciences, the quantitative procedures and the methods of devising models of physical structure lasted in the minds of scientists at least until the turn of the 20th century. These modes of thought supported not only science and technical engineering but also many phases of philosophy. Newtonian science presented the somewhat dismal outlook of a world which was continually running out of available physical energy, but this seemed too slow for much concern. Nevertheless, people believed for a while at least that if only man could build all of his models into one, he could fully understand the universe and that, short of this, the more comprehensive the models, the better he could control his destiny. This led to the feeling that the world was like an intricate mechanism planned to run like a great clock and, for uncounted eons to come, continuing progress was assured.

In the days since 1700, technical engineering expanded in every conceivable direction, and engineering purpose grew in depth. I cite just one more example. This from 90 years ago is chosen to show the broadening scope.

Roughly one decade after the close of the American Civil War, James Buchanan Eads undertook to span the Mississippi at St. Louis with 500-foot-long arches. This was for a relatively modern purpose. For a growing nation of free people, the purpose was to keep St. Louis a great gateway to the west. Eads walked 65 feet below the flood waters, in a diving bell of his own design, to feel the submarine currents undermine and shift the sands. In air locks to reach down 135 feet to bedrock, he combatted, with medical aid and ideas of his own, the little known bends which killed his men. With William Chauvanet, chancellor of Washington University, St. Louis, as his mathematical advisor, Eads computed stress—considering, at least, both circular and parabolic arch. Through President Grant, he fought off the order of Army Engineers telling him to stop construction and, at the same time, he faced down opposition from rivermen and steam boat operators. He compelled Andrew Carnegie's steel company to deliver modern steel. Carnegie makes reluctant admission in his autobiography to this demand, but the steel was forthcoming in accord with the new metallurgy of the Bessemer and open-hearth processes. This bridge, a triumph for Eads, the modern engineer, opened in 1873, and, to this day, stands to serve the purpose for which it was designed.

20th Century
Science, Philosophy, and Engineering

Science, engineering, and philosophy carried on with the Newtonian approach until around the turn of the present century. The use of material symbols resembling elements of the visible world, and the resulting model theory remained useful and, at times, were even mistaken for reality itself.

The new science evolving in the 20th century retained the methods of thought and also experiment to check hypotheses; but it developed new symbols. Time and space were interrelated to yield a sort of four-dimensional framework. It made mass and energy interchangeable. And soon it developed probabilistic sorts of viewpoints in place of more simple, casual laws. The models and symbols were recognized as not strictly reality but, figuratively speaking, more nearly like reflected light which permitted a degree of interpretation. These developments supplemented Newtonian science. What may prove of equal importance, they bid fair to shatter much of materialistic and rigorous philosophy and in its place leave room for new symbols which are more compatible with simple yet clear observations regarding life and human affairs.

As in the past, engineering is adapting the new science to its arts even though the process is on a greater scale and is

accelerating. And, much as in the past, engineering is applying these developments for the present-day purposes of mankind: to erect monuments, to create wealth, to win wars, and also to aid in relieving poverty and disease.

However, science has changed and greatly expanded. Not only the applications, but also their purposes must be expanded. In the early days, engineering was "know how," not scientific; and its purposes were quite contemporary. Today, engineering has become scientific, but, and, I repeat, by any means whatever, its purposes must be extended.

Future Engineering

Problems and purposes which affect modern engineering spread wide across the world and engineering itself lies in a broad spectrum of thought. At one end, it merges with science. It extends through the detailed technical phases and on to the administrative, where we find it impinging upon many areas of government.

Near the scientific end of this spectrum we see new and future developments in materials, in power, and in thought. There should come the ability to design almost at will, even though with great effort, new materials hitherto never seen upon the earth. Soon new sources of power will be available for any location. We see, now, new aids to thinking and control, applicable not only to physical problems, but also serving as increasingly powerful aids to decision making in business and in government.

Over the past 100 years, engineering colleges have taught a good deal about engineering economy—the arts of design and compromise to meet economic requirements. Today, engineering has additional goals to meet: weight, size, and various kinds of reliability. Beyond these are others which must remain undefined by physical measure. Among them are industrial peace and justice, the conservation of natural resources, and problems of true social gain. All these should present challenges to engineering education.

Seemingly terrifying problems arise from the desires of many peoples. Various ill-conceived combinations of science, engineering, business, and government have served as catalysts in bringing emotions near the boiling point. If we continue as we go, soon each country (or ruler) may possess the power to destroy another. If, on the earth, we reach this unenviable state, it will be like living in a locked room full of strange men where each holds in one hand a knife for little wars and in the other a bomb.

What then can we say of engineering education at home and overseas? In both areas, engineering needs call for a more scientific base, and for this the new undergraduate curricula seem well planned. Consider the more highly selected men. Experience leading to more technical and scientific work is needed for many who will work in this country; abroad, young men may come sooner to consultative and operating engineering posts. As in the past, many from both groups will go into administration. Graduate training for all of these highly selected men now must be provided. This calls for a changing outlook. Instead of applied scientists alone, advance study must also produce highly trained practitioners somewhat as it does, today, in the various fields of medicine.

At the present moment, the most difficult job in engineering teaching seems to be that of training the scientific—engineer. This is because we still must train a man in research by doing actual research and not with synthetic stuff. To give such training, we need very able and experienced teachers. We are much too ready to draw potential teachers into engineering practice where they may work wonders but do too little to pass their methods on. This tendency is being partially corrected in some areas of the country by using the talents of certain of the men of industry for daytime as well as for nighttime teaching. This can be a great help, but it alone will not solve the problem. More of the scholarly students need further encouragement to stay in teaching and research. There are many long-range engineering problems of particular interest to specific industries. Many such could be supported through consulting arrangements with specific young engineering teachers. These are the men qualified to produce in their own right as engineers and qualified to develop other young men in areas of special competence. This does not present an expensive procedure, only one which is commonly ignored. The primary problem remains. It is to spend a little more of our highest skill on developing new young talent.

In the past, many engineers for the less-developed areas of the world have been Europeans and European trained. Apparently, the training has been sound, often more applied than ours is at present, and usually with less emphasis given to the humanities.

I am inclined to guess that, on an immense scale, the USSR is to replace Europe in exporting engineers whose technical training will be admirably suited to the needs of the less-developed lands. I simply cannot believe that from the Soviet Union's tremendous outpouring of engineering graduates, anything else may be expected overseas. These men, of course, will render service. Also, they will serve as business emissaries and as missionaries to spread their doctrine.

Except for brief stays and sheltered living, we seem to have few engineers for export. We need sharp changes if we are to increase our own training of students who could come to us from abroad. We need actual recruitment as well as better methods for evaluating the applicant's probability of scholastic success. (Scholastic failure for these men can be catastrophic.) We need ways to provide for the financial support of these students because we cannot use the foreign nationals on classified research, neither can we assume them qualified to teach before we have even seen them. We need to develop engineering educational programs geared to *their* needs and *not* to assume without plans, as we commonly do for our own young men, that American industry will provide somehow for a large proportion of these young men's practical experiences.

Electrical Engineering Education

For all young engineers of either domestic or foreign origin, it may be that we should expect more enlivening experiences from our courses in the humanities. This I am hardly qualified to judge, but, in increasing numbers, the strongest young men will go on to graduate study. Eventually, perhaps soon, it will be recognized that all advanced study in engineering need not be pointed at scientific and technical research alone—some work should be directed toward administrative training regardless of one's major field of study.

Why must we allow general studies in the humanities and social sciences to terminate with the baccalaureate degree? Should these not continue for all graduate engineering programs? Something has to give way, of course, and I look skeptically at the so-called reading knowledge of technical German and French. Much time is expended; few retain any skill. Soon there may be six or eight technical literatures to search, and most of the men remain woefully incompetent as amateur searchers in two. Almost none achieve a speaking knowledge of any foreign language. But I return to the idea of extended work in the humanities. Here, through inter-school seminars, library searches, and papers, able and strong-minded young men from home and abroad should mingle to grow in knowledge, wisdom, and working principles. With the ever-increasing ease and occurence of travel, I envision that often times these men will meet again and continue with their discussions.

For our own young men and for many from abroad, we must seek to extend that component of progress which lies in the direction of purpose, for in this direction lies faith in the future. To explain this in a classroom is like trying to pin down with your finger a drop of mercury on a table top, yet each man, from his own viewpoint, may still believe in its shining existence and realize that it mirrors light from a source beyond the room. In a direction such as this lies purpose, and here also may be the beginning of understanding.

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Electrical Engineering Education

Nuclear Training Reactor for University of Kansas

A nuclear training reactor for the University of Kansas will be built by the Research Laboratories Division of Bendix Aviation Corporation.

The award of a contract by the University for the 10,000-watt unit to be completed early next Fall was announced recently by Dr. W. E. Kock, general manager of the division.

He said the reactor will be a tank type, using highly enriched Uranium-235. The tank will measure 7½ feet in diameter, and will be 20 feet deep. This design permits easy access to the reactor through the ordinary water which acts as a shield, slowing down neutrons, and also acting as a coolant.

The unit will meet all requirements of the Atomic Energy Commission (AEC), and is specially designed to be used by engineering students on reactor design or for experimental purposes, such as in studies of the effects of radiation on material and the preservation of food.

One of the facilities included in the installation is called a "thermal column" and consists of a solid duct of graphite which channels neutrons from the reactor through the concrete shield for experiments. The graphite also reduces the energy of the neutrons.

Beamhole facilities also are included in the form of tubes approximately 6 inches in diameter and 7 feet long. The tubes penetrate the shield to the reactor to facilitate the placement of material or equipment near the reactor, or to permit the emission of fast or slow neutrons.

Dr. Kock said other nuclear projects in which Bendix is participating include the construction of a research reactor for the AEC nuclear aircraft propulsion project, the manufacture of control rod drive mechanisms for several of the nuclear engines in the U. S. Navy's nuclear propulsion program, the development of control rod mechanisms for an AEC nuclear-powered rocket project, and transistorized nuclear instrumentation.

Summer Short Courses at Case Institute of Technology

A series of three short courses dealing with automatic control and process control theory will be offered this summer to practicing engineers and college teachers by the mechanical engineering department at Case Institute of Technology.

Directed by Dr. D. P. Eckman, professor of mechanical engineering, and Dr. Irving Lefkowitz, assistant professor of mechanical engineering, the three courses will vary in length from 4 days to 3 weeks.

The first course in process control theory, offering new concepts of automatic control including data processing, computer control, and information theory, will be offered June 15-29 to practicing industrial and governmental engineers holding a college degree in science or engineering. It will cover the application of dynamic analysis and frequency response techniques to typical control processes.

A 4-day course in automatic optimizing and computing control will begin June 29, again for practicing engineers and scientists. It is a specialized and intensive course for the engineer or scientist interested in the problems of control systems, and will cover predetermined, self-determined, and direct optimizing techniques for handling problems in process control, power distribution, and homing and guidance.

A course designed to acquaint college teachers of chemical engineering with methods and techniques of dynamic analysis applied to process control will be offered July 6-24. It will cover the same area as the earlier course on process control theory for engineers and scientists, but will be presented over a longer period of time. Fees for the 2-week process control theory course, June 15-29, will be $275 while the 3-week course will require a $375 fee. The 4-day course on automatic optimizing and computing control, June 29-July 3, has a $175 fee.

With increased emphasis on science in this atomic–space age, Case has greatly expanded its office of Special Programs under Director Dr. J. R. Hooper in order to meet the resulting need for more courses which can be made available to persons who must help meet the challenge. While summer vacation period presents an ideal time to hold such programs with the large majority of regular students away from the campus, Case continues to offer short courses in many areas of study throughout the year.

Additional information on short courses and fellowship programs may be obtained from Dr. J. R. Hooper, Director of Special Programs, Case Institute of Technology, Cleveland 6, Ohio.

Soviet Visitors Discuss Engineering Education

Students in the United States do not enter the university at as high a level of education as do their Soviet counterparts, nor do they graduate with the same degree of technical background, five USSR engineering educators said on January 30 at Northeastern University.

The spokesman from the Soviet Union continued by adding that he felt American students gained more of their technical background after beginning work in industry itself.

Prof. Panteleimon Lebedev, Soviet tour leader, Soviet Ministry of Education, assumed the spotlight as he replied to questions from the press regarding the Soviet system of engineering education in institutions of higher learning.

The remaining four members of the team did not speak until specifically addressed by reporters at the close of the conference. At this time, they offered only general comments on their hurried observations of American education since their arrival in this country in January.

Prof. Lebedev then admitted that Soviet Union educators are currently considering reducing the numbers of years spent studying technical matters in school due to the rapid change in modern technology, thereby acknowledging that the American system may have its merits.

Speaking on the possibilities of establishing exchange student programs between Soviet and American universities, Prof. Lebedev expressed interest in such a program conducted on the graduate level. Although he asserted that the Soviet doctorate degree is on a "substantially higher level" than the American degree, Prof. Lebedev said the Soviet Union would be interested in sending students to the United States to study under our programs leading to a master's degree.

In the Soviet Union, scientists wishing to study for a doctorate must complete 5 years of college undergraduate work in addition to 3 years of graduate research, at which time they may become candidates for the degree of doctor of science. Only after many years of original research, culminating in a thesis of significant scientific contributon, can a scientist achieve the title of doctor. Because of these rigid requirements, the Soviet Union is currently facing an acute shortage of professors of college engineering.

Part of the reason for the Soviets' visit to Northeastern was to observe the University's Co-operative Plan of Education. Under the "co-op" system, upperclass students alternate 10-week periods in the University with periods of equal length on regular paying jobs in business and industry.

Prof. Lebedev said that the Soviet Union was currently considering the possibility of establishing a comparable system of education for the first 2½ years of college, and that some experiments along this line are already in process in Soviet high schools.

Asked whether or not Soviet engineering students suffer from the same deficiency in knowledge of the liberal arts attributed to American engineers, Prof. Lebedev admitted that a similar problem did exist. To counteract this, he stated that numerous extracurricular activities in the area of literature and the arts were currently being initiated. He also spoke of the organization of many student tour groups to the satellite countries and East Germany. No mention was made of organized tours into the Western European countries.

Prof. Lebedev spoke of the delegation's interest in the diversified approaches to engineering education at the universities they have visited thus far. Prior to their visit to Northeastern, the Soviet delegation visited the engineering schools of Yale University and the Massachusetts Institute of Technology.

W. T. Alexander, dean of the Northeastern College of Engineering and president of the American Society of Engineering Educators, served as host to the

Soviet visitors. Their visit was under the sponsorship of the American Society for Engineering Education (ASEE) and the Department of State as the "return half" of an exchange mission on engineering education under which eight American engineering faculty members visited the Soviet Union for 3 weeks late last Fall. Dean Alexander was a member of the American delegation to the Soviet Union.

While in the United States, the Soviet team planned to visit 10 American universities, including: the University of California, Stanford University, University of California at Los Angeles, California Institute of Technology, University of Illinois, Tulane University, and North Carolina State College. They returned to the Soviet Union February 14.

Members of the team included Prof. Lebedev; Prof. N. P. Bogoroditskii, director of the Leningrad Electro-Technical Institute; Prof. K. M. Barshauskas, director of the Kaunas Polytechnic Institute; Prof. V. I. Atroshchenko, deputy director, Kharkov Polytechnic Institute; and Prof. A. B. Davankov, lecturer, Mendileev Chemical Technological Institute, Moscow.

The Soviet team was accompanied by F. B. Stevens, retired Foreign Service Officer, and formerly Department of State director of the Office of Eastern European Affairs. Miss Natalie Kushnir served as the Department of State interpreter.

Philip Sporn Fellowship Available at Ohio State

The Catherwood Foundation has announced that the Philip Sporn Fellowship of $2,500 per annum for graduate work at The Ohio State University in the field of Electric Generation and Distribution will be available again this coming year, 1959-60. The payments are applied first to tuition expense, and the remainder is paid directly to the recipient of the fellowship. Tuition is $90 per quarter and out-of-state fees for nonresidents of Ohio are waived. The only requirement necessary to qualify for this fellowship is that the applicant must be a citizen of the United States.

Applications and requests for further information should be addressed to the Graduate School, Ohio State University, Columbus 10, Ohio.

Experimental High-Power Radar Designed by Lincoln Laboratory

Lincoln Laboratory of the Massachusetts Institute of Technology (MIT) has completed the construction of and is now operating a new high-power experimental search radar on Boston Hill in North Andover, Mass. This radar is the direct result of experimental work on a less powerful installation at Jughandle Hill, Bath, Maine, which has now become a part of the Experimental Sector of the SAGE Air Defense System. Boston Hill will be used by Lincoln Laboratory to test new high-power radar components and circuitry developments that are being designed for radars of the future.

Lincoln Laboratory is engaged in electronic research on new problems of air defense and is supported by the U.S. Army, Navy, and Air Force. Lincoln's triservice contract is administered by the Air Research and Development Command of the Air Force through the Air Force Cambridge Research Center in Bedford, Mass.

Even though the antenna assembly weighs more than 50 tons, it can be rotated at speeds up to 5 rpm in winds of 60 mph and still maintain an accuracy of less than $\frac{1}{10}$ of a degree. The reflector measures 120 feet wide by 30 feet high—50% larger than the next largest of its type in operation.

In order to assure long life with continuing accuracy for such a large antenna, extensive effort was devoted to the design and fabrication of the bearing and structure on which the antenna is mounted. The 4-point-contact azimuth bearing is the largest integral gear and ball bearing yet installed, 13½ feet in diameter, with 110 three-inch diameter balls matched to 0.0001 inch—$\frac{1}{30}$ the thickness of a human hair! The bearing problem was so complex that its solution forced the state of the art to advance considerably and the momentum imparted promises still further progress.

Unlike most radars, the Boston Hill antenna is mounted on a heavily reinforced concrete tower that houses the transmitter, receiver, and the ancillary equipments, a workshop, and offices. The tower construction provides the very rigid platform necessary for the high degree of accuracy of the antenna.

The output or power tube of the transmitter is a 10-foot klystron that was specifically developed under Lincoln Laboratory sponsorship for use in this radar. Transmitter energy is developed in the form of recurring pulses, each of which lasts for a few millionths of a second. This energy can be directed into space by the antenna or, for test purposes, into a dummy load.

The receiver is sensitive enough when combined with the high power of the transmitter, to detect a small plane several hundred miles away. To protect the receiver from damage by the high power of the transmitted pulse, a unique tube filled with pure argon gas is used. The gas ionizes when the pulse strikes it and prevents all but about one millionth of the energy from passing to the receiver.

In order to provide a platform stable enough to permit the required positional accuracy of the antenna, the walls of the tower are of reinforced concrete 14 inches thick. The tower is 82 feet high, 36 feet square, and has six reinforced concrete floors which increase the torsional rigidity of the tower and provide space for the equipment.

A NEW experimental high-power radar, designed by the Lincoln Laboratory of MIT, recently went into operation at Lincoln's Boston Hill site, North Andover, Mass.

Electrical Engineering Education

ASEE–ASTM Symposium on Education in Materials

Today's engineering students, already burdened with heavy schedules, must learn more than ever before about the materials they will use. Reactors, rockets, and space vehicles impose severe new environments; and reliability must be sharply increased.

How can engineering materials be better

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taught to engineering students becomes a vital question.

To explore the situation, two of the Nation's societies most concerned with this problem, the American Society for Engineering Education (ASEE) and the American Society for Testing Materials (ASTM), will sponsor jointly a symposium on Education in Materials at the ASTM Annual Meeting in Atlantic City, N.J., June 22-26, 1959.

Tentatively scheduled June 22, 1959, as the feature of the first day of the Annual Meeting, the symposium will include an introductory paper by Prof. K. B. Woods, ASTM president, head of the School of Civil Engineering at Purdue University. The ASTM viewpoint on the subject will be presented by F. L. LaQue, ASTM senior vice-president and vice-president and manager of the Development and Research Division, The International Nickel Company, Inc. The educators' viewpoint will be given by Dean W. T. Alexander of Northeastern University, president of ASEE. Requirements in materials education from the viewpoint of industry will be discussed by two speakers representing the leading industries in the United States.

The symposium will be concluded by a summary or a survey of projected degrees in materials engineering now being considered or initiated in many engineering schools.

A special luncheon with a nationally prominent speaker discussing engineering education will tie together the morning and afternoon sessions.

This symposium has been under consideration for several years as a joint project of the two societies and is being organized to fulfill an evident need to discuss present and future requirements for courses in materials in engineering curricula. The subject has had intensive consideration in ASEE in connection with growing interest in education in the engineering sciences. Emphasis on engineering materials is a logical development in the effort to increase the basic science available to engineering students today.

The symposium will follow by 3 days the ASEE's 1959 annual meeting in Pittsburgh, and many ASEE members are expected to extend their trips and participate in the joint session at the ASTM meeting. The symposium will be open to visitors as well as to members of both societies, and anyone interested will be welcome to attend.

First National Youth Conference on the Atom

A national Youth Conference on the Atom, the first such meeting of high school science students and teachers to discuss the peaceful uses of nuclear energy, will be held in Atlantic City, N.J., April 30–May 1, 1959.

Approximately 500 junior and senior high school science students and teachers will be sponsored in attendance at the Conference by 60 or more electric utility companies throughout the country.

Organizations co-operating in the Conference include the American Association for the Advancement of Science, Atomic Industrial Forum, Future Scientists of America Foundation, National Science Foundation, National Science Teachers Association, and Science Clubs of America.

The 2-day Conference at Atlantic City's Claridge Hotel is being held, sponsors said, to inform students and teachers about the many uses of the peacetime atom, and to help advance interest in the study of science.

Chairman J. A. McCone of the Atomic Energy Commission (AEC) will address the Conference on April 30.

Also speaking will be Dr. N. C. Hilberry, director of the Argonne National Laboratory; C. E. Robbins, executive manager of the Atomic Industrial Forum, who will tell the young scientists about industrial uses of the atom; Dr. Cyril Comar, director of the Laboratory of Radiation Biology at Cornell University, who will describe the use of the atom in agriculture; and Dr. John Laughlin, chief of the Division of Physics at Sloan–Kettering Institute for Cancer Research, who will speak on the uses of the atom in medicine.

Forecasts of the atom and the world of tomorrow will be presented by Vice-President F. K. McCune of the General Electric Company and Vice-President C. H. Weaver of Westinghouse Electric Corporation, who are in charge of atomic activities at their respective companies.

AFIT Receives AIEE Student Branch Charter

Air Force Photo

Air Force Photo

ON JANUARY 22, 1959, the AIEE Dayton Section met at the Air Force Institute of Technology (AFIT), Wright-Patterson Air Force Base, to install the new Student Branch. Above, left: W. H. Chase (second from left), AIEE vice-president for District No. 11, presents the charter of organization to Brigadier General C. E. Combs (second from right), commandant, AFIT, who received it in behalf of the student body. Observing the presentation are Captain J. J. Thompson (left), chairman of the Student Branch, and B. J. Pleiss (right), chairman of the Dayton Section. Above, right: Elected officers of the AFIT Student Branch are: (standing, left to right) 1st Lt. D. Stone, Captain D. L. Phillips, Captain E. A. Merritt, 1st Lt. J. H. Thompson, 1st Lt. E. P. Shelonka, (seated, left to right) Captain E. R. Bissell, Branch Counselor Prof. T. L. Regulinski, Branch Chairman Captain J. J. Thompson, and Captain R. E. Rauch. The program included a welcoming address by General Combs followed by a tour through the school facilities to see the computer; the atomic and nuclear physics, machinery and communications, and mechanical engineering laboratories; the subcritical reactor; and the wind tunnel.

The students and teachers attending the Conference will tour the AEC's new 1959 version of its major "Atoms for Peace" exhibit, which will visit Atlantic City during the week of the Conference as the first stop in a nation-wide tour. In addition, the AEC and more than 25 other organizations will have exhibits at the Conference site.

Dr. B. D. Wood, director of the bureau of Collegiate Educational Research at Columbia University, is serving as educational consultant to the Conference.

Students who will attend the Conference will be chosen in co-operation with local school authorities in a variety of ways, ranging from selection by school principals to essay contests and special examinations. They will be selected for their excellence and interest in science, particularly physics.

The program for the Youth Conference is being arranged by the Electric Companies Public Information Program.

Wall Chart Available of Electronic Schematic Symbols

A new clearly illustrated wall chart of electronic schematic symbols is available to the teaching profession from Electronic Instrument Co., Inc. (EICO) Long Island City, N.Y.

This easy-to-read training aid has diagrams of all the basic electronic schematic symbols and is very useful for student classroom reference or for actual demonstrations in the teaching of basic courses in electronics.

This large (22-inch by 28-inch) two-color chart is printed on heavy plastic-coated, wrinkle and tear resistant, washable, nonfade Texoprint that will last for many years. The chart is also fitted with brass eyelets for easy handling.

Free chart on request to EICO, 33-00 Northern Blvd., Long Island City 1, N.Y.

Intensive Course in Automatic Control

The University of Michigan, College of Engineering, has announced a summer Intensive Course in Automatic Control scheduled for June 15-24, 1959, inclusive. The course is designed for practicing engineers who need or desire to obtain a basic understanding of modern automatic control, but who can spare only a few days from their work. The course objective is accomplished by presenting the fundamentals of automatic control and by providing a comprehensive set of notes which will serve as a framework for further study.

The course is built around the principles and application of measurement, communication, and control. The material will begin with fundamentals in each of these fields and will be followed by applications of the fundamentals to important automatic control problems. Topics treated include: response of linear systems, instruments and instrument errors, analysis and synthesis techniques for linear automatic control systems, statistical considerations of measurement, elementary communication and information theory, an introduction to theory of nonlinear systems, the analysis and synthesis of nonlinear servomechanisms, sampled data servos, and servos with noise. There will be lectures each morning and laboratory demonstrations in the afternoon. The role of analog computing methods will be emphasized. This course is a revised version of the summer Automatic Control Course given since 1953.

April 15 is the closing date for registration. Further information may be obtained by writing Professor E. G. Gilbert, Room 1521, East Engineering Building, University of Michigan, Ann Arbor, Mich.

Boettcher Foundation Presents Grant to University of Denver

A grant of $1.25 million from the Boettcher Foundation has been made to the University of Denver to finance the start of construction on a Science–Engineering–Research Center on its University Park campus.

Announcement of the grant, one of the largest ever given by the Boettcher Foundation, followed its acceptance by the executive committee of the University Board of Trustees at a special meeting.

The objective of the Center will be to integrate teaching and basic research in the physical sciences of chemistry, physics, and mathematics and in the applied fields of mechanical, civil, chemical, electrical, and metallurgical engineering with applied research functions of the University's fast-growing Research Institute. The latter, one of the nation's 10 largest of its kind, currently is conducting a $2.5 million program in sponsored research for industry and the Government.

By the unanimous vote of the executive committee at its special meeting, the complex will be named the Boettcher Center for Science, Engineering, and Research of the University of Denver. The site on which it will be located has not been established pending an over-all campus development study which the trustees have authorized the University to undertake, Chancellor Alter declared.

Members of the University's science and engineering faculties and research staff have been working for more than a year with the Chicago architectural and engineering firm of Perkins and Will to determine priority space needs in terms of both current and future programs. As a result of these meetings, immediate space requirements have been placed at approximately 200,000 square feet with initial building costs estimated between $4 and $5 million exclusive of the equipment they will house.

The $1.25 million Boettcher grant will finance the first facilities foreseen for the development at the private, non-tax supported University. Confidence that other foundations and interested individuals will provide the remainder of the funds necessary for the Center was expressed both by the Boettcher Foundation in making the grant and Chancellor Alter in accepting it.

"The sciences of chemistry, physics, and mathematics are the sources from which much of technological advance derives. The basic organization of buildings and the programs conducted within them will reflect this vital interrelation in a Center unique in both concept and design," Chancellor Alter declared.

"In seeking integration of the sciences, their uses in the fields of engineering, and the application of both in the vast areas of research, the Boettcher Foundation has made it possible for the University to embark on a pioneering educational enterprise affecting these vital and swift-moving areas," he said.

Electrical Engineering Education

Automatic Check Processor To Aid Engineering Students

A unique data processing system for banks, developed at a cost of $1 million, will serve professors and students as an experimentation and training tool in the department of engineering at the University of California, Los Angeles (UCLA).

Presented to UCLA by Telemeter Magnetics Inc., of Los Angeles, a subsidiary of Paramount Pictures Corporation, the Telemeter Check Processing Machine is the only model of its kind.

In the machine, a punched tape, containing all necessary information for routing the check through bank channels, is attached to each check. The checks are then sorted and items are computed and reconciled, all automatically.

The prototype machine, which has has never been put into production, comprises four major elements—a tape-affixing machine, a central electronic computer, a printer, and an electromechanical sorter.

The system will be used at UCLA by faculty and future engineers to study, modify, and experiment on a small but complete data processing system.

Appointments and Awards, Engineering and Science Faculty

University of Wisconsin (UW), Madison, Wis. Prof. G. J. Baker is retiring after 37 years of service in the UW College of Engineering's department of mining and metallurgy. During his career, Prof. Baker has been very active in the American Foundrymen's Society. He was one of the founders of the Foundry Educational Foundation.

University of Michigan (U-M), Ann

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Arbor, Mich. The following three appointments in the U-M College of Engineering have been approved: Newbern Smith, who has been on the staff of the University's Willow Run Laboratories since 1954, was named as professor of electrical engineering; Kuei Chuang, research associate at Willow Run, was appointed assistant professor of electrical engineering; Andrejs Olte, research and teaching assistant at the University of California, was appointed as a half-time assistant professor of electrical engineering.

Worcester Polytechnic Institute, Worcester, Mass. L. J. Hooper, professor of hydraulic engineering at Worcester Polytechnic Institute and director of the Alden Hydraulic Laboratory has been appointed chairman of the advisory committee and director of the secretariat for the Test Code Committee for Hydraulic Turbines. The advisory committee operates under the U. S. National Committee, a part of the International Electrotechnical Commission.

Pratt Institute, Brooklyn, N. Y. Dr. R. H. Cook has been appointed dean of Pratt Institute's School of Engineering. Dr. Cook has been chairman of the departments of mathematics and physics in the Engineering School at Pratt since 1957. He replaces Dr. W. E. Wilson, who resigned to accept a post at Harvey Mudd College, Claremont, Calif.

New York University (NYU), New York, N. Y. Prof. H. A. Giddings, chairman of the department of mathematics at NYU's College of Engineering, has been named director of the NYU Graduate Center at the Bell Telephone Laboratories in Murray Hill, N.J. S. S. Shamis, associate professor of electrical engineering, has been serving as acting director of the Center since its establishment in the fall of 1957. He will return to full-time teaching and research work at the College of Engineering.

GE Presents Edison Radio Amateur Award

J. M. J. Madey, 18, of Clark, N.J.—one of a family of four licensed radio amateurs—has received the General Electric Company (GE) 1958 Edison Radio Amateur Award for public service.

Mr. Madey was cited for handling thousands of messages for personnel at isolated Antarctic, Arctic, and South Pacific posts. He spends an average of 90 hours a week at his home radio station K2KGJ and is reported to have transmitted more than 12,000 messages during the past several years. Two years ago he received a special citation for this work in the Edison Award program and last year he received an Edison Award commendation certificate and a public service award from the U.S. Navy.

Mr. Madey finished high school last June with high honors, has been active in local civil defense and other community activities, and his work has been featured in several leading magazines and newspapers. He won student science fair honors several years ago for inventing an ultrasonic drill which aroused interest among engineers. He now has plans for building a system for creating man-made "whistlers," the eerie high-frequency sounds in space which are attracting scientific attention.

"100% Club" at Tulane University

EACH STUDENT in the senior electrical engineering class (above) at Tulane University is a member of the Joint AIEE–IRE (Institute of Radio Engineers) Student Branch, thus constituting a "100% Club." Of the 42 members in the Student Branch organization, 21 form the "100% Club" of the senior class. Pictured with the seniors are Prof. George Webb, Student Branch counselor (*top row, far right*), and Prof. J. A. Cronvich, department head (*second row, far right*). Student Branch officers at the University are Will Lannes, chairman; S. P. Williamson, vice-chairman; Richard Fastring, treasurer; Demitri Valhos, AIEE secretary; and Ronald Jacobs, IRE secretary.

Closed-Circuit TV System at U. S. Army Signal School

The world's largest military closed-circuit educational television system was placed in operation on February 6 by the U. S. Army Signal School, Fort Monmouth, N. J.

Signal School officials formally accepted the newly expanded seven-channel system, which employs Radio Corporation of America (RCA) television cameras for both live and film programming, associated studio equipment, and 468 receivers bringing instruction courses and other training material to a student body of 6,000 men.

"Inauguration of this system marks a major milestone in the growth of educational television, military and otherwise," said C. H. Colledge, general manager, RCA Broadcast and Television Equipment Division, who took part in the acceptance ceremony. "Signal Corps specialists are carrying on one of the most extensive educational television projects in the nation—with outstanding results."

"Television is no longer an experiment at the Army Signal School," said Brig. Gen. A. F. Cassevant, Fort Monmouth commander and school commandant. "This new, expanded system makes it possible to put programs over the closed circuit network for practically any of the Signal School's 65 communications courses."

Gen. Cassevant said the television system is expected to "pay for itself" within a year in terms of man-hours saved. This saving, he said, is expected to result from the elimination of individual motion picture projectionists in each classroom and the fact that trainees can remain in their "home rooms" for a variety of courses that formerly required group movement to widely scattered training areas.

A pioneering force in the field of educational television, the Signal School started in 1951 with a single television camera which had served as part of a

touring military exhibit. Additional equipment was incorporated until 150 classroom receivers were being served. The new system more than triples that figure. Whereas only about one fourth of the school's trainees were receiving television instruction, virtually every student now will be taught in part by televison.

The program schedule has been increased to 80 hours a week with students receiving instruction in a wide variety of subjects, including television and production techniques to be utilized in establishing or enlarging other Army television installations.

Some 35 monitors are located in the base hospital so that patients can keep pace with their classmates while recovering from accidents or illness.

In five central locations, big screen projectors permit the viewing of programs by larger audiences. Utilizing the complete systems, a single program can be viewed by as many as 15,000.

Expansion of the former three-channel system made possible operation of a complete production studio with the latest professional equipment and a film studio capable of feeding up to six programs into the television system simultaneously. The additional receivers provide practically complete classroom coverage throughout the school.

"We are using television to supplement rather than replace the classroom instructor," said Col. A. L. Burke, director of the Department of Specialist Training, "and when we find areas where television can do the job effectively, we want to use television."

Studies conducted at the Signal School have pointed to the value of educational television. One such study finished in 1953 dealt with 6 classes of trainees given television instruction and 15 taught by previous methods. The average grade for the television trainees was 91.0 while the average for the nontelevision students was 87.2

The system studio is located in Myer Hall, principal classroom building for the Signal School. In the master control room, Signal Corps technicians regulate the audio and video signals being transmitted with the help of eight monitors—seven linked to the operating channels and the eighth serving as a pre-view instrument for the program director.

In the studio, there are three RCA *TK 11* image orthicon cameras, of the type used by many commercial black-and-white television stations. There also is an RCA color television camera.

In the adjoining film room, there are six film "chains," including four RCA *TK 21* vidicon film cameras for high quality reproduction of monochrome motion pictures or slides. The projectors are the RCA type *TP 16*, designed for long periods of continuous operation.

Although the bulk of the programming originates in the studio area, the system includes provision for remote pickups from some of the classrooms and from outdoor training sites.

In addition to the normal instruction schedule, the television system is used for troop information programs on safety, character guidance, and similar subjects.

The television activity is handled by the Television Division, Department of Specialist Training, and consists of 25 enlisted technical and production specialists, 2 RCA field representatives, and 3 Army officers.

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Lehigh University Receives $10,000 Bequest

Lehigh University has received $10,000 through a bequest of the late Stewart J. Cort, former vice-president of the Bethlehem Steel Company, E. W. Glick, University treasurer, announced recently.

By action of the University's board of trustees, this sum will be added to a scholarship endowment fund established by the late Mr. Cort and brings the total of this fund to $45,000.

Mr. Cort, a graduate of the electrometallurgical curriculum in the Class of 1906 at Lehigh University, was a member of the Lehigh board of trustees from 1942 until his death last September.

Income from the fund, which the trustees have designated as the Stewart J. Cort Fund, is to be used for awarding scholarships. The recipient shall be a candidate for admission to the College of Engineering at Lehigh University, preferably in the metallurgical engineering curriculum or in the combined arts–metallurgy program.

The basis for the award shall be financial need, high scholastic achievement, character, personality, and leadership qualities. The amount of each award will be dependent on the income that is available from the fund.

With these limitations, the University's committee on scholarships and loans may award an amount not less than $200 and not more than $2,000 depending upon the financial need of the candidates.

EJC Reports on Earnings of Engineers

Engineers' salaries are going up an average of 6½% a year and the *median* salary of engineers in industry, Government, and education in 1958 ranged from $6,125 annually for engineers with one year of experience to $11,000 for those with 20 years experience, according to the third in a study series "Professional Income of Engineers," prepared by Engineers Joint Council (EJC).

Copies of the report are available from the Engineering Manpower Commission, 29 W. 39 St., New York 18, N. Y., at $3 a copy—slightly lower in bulk.

This survey is the most comprehensive ever completed in the United States and covers a sampling of nearly 200,000 engineering graduates.

In spite of the recession, the 1958 graduates had plentiful job offers and starting salaries were higher than in 1957. Those with a Ph.D degree commanded a median starting salary of nearly $10,000 in industry.

Significant in the salary picture is the increase in the past 2 years for engineers in Government, part of which was the flat increase granted by Congress in 1958 for Civil Service engineers. Although salaries of engineers in Government increased percentage-wise more than those in industry, this relative rise has not yet placed Government employment in a competitive salary position with industrial employment.

EJC's report contains data on engineers' salaries in 26 subdivisions of industry (155,124 engineers), including separated Ph.D., Sc.D., and M.S. graduates. Engineering salaries in all levels of Government (30,028 engineers), separated into Federal, State, and local categories, college teachers (over 4,000), technical institute teachers, and engineering societies have been covered by the report. The report, for the first time, delineates the salary structure of more than 25% of the nation's engineering force.

Earnings of engineers continued their upward trend, observed in the previous survey interval, 1953-56. The over-all median (for all graduates) was $6,500 in 1953; $7,750 in 1956 (19% increase or about 6.5% annually); and $8,750 in 1958 (up 13% from 1956 or 6.5% average yearly). The latter represents an increase from mid-1956 to mid-1958. For this same 2-year span, the Consumer Price Index rose 1.5% and the Average Gross Weekly Earnings for Production (Manufacturing) climbed close to 10%.

The EJC studies have revealed a strong upward trend in earnings in industry between 1953 and 1956. Although industry, particularly, was adversely affected by the recent recession, this upward trend in earnings continued, although at a slightly reduced rate.

Summary income data; median as provided below:

Annual Earnings (Medians)

Years of Experience	Industry	Government	Engineering College Teachers
1	$ 6,175	$5,675	$ 5,425
5	7,450	6,850	6,400
10	9,325	8,325	8,625
16	10,425	9,050	9,875
26	11,350	9,325	10,850

INSTITUTE ACTIVITIES

East Central District Meeting and Rubber and Plastics Technical Conference

AKRON, OHIO, the Rubber Capitol of the World, will be the site of the AIEE East Central District No. 11 Meeting, April 22-24, 1959, at the Hotel Sheraton. The Rubber and Plastics Subcommittee will hold its 11th Annual Technical Conference in conjunction with the District Meeting. General theme of the meeting is "Electricity—Major Tool of Industry."

Akron is 35 miles south of Lake Erie and ports of the Great St. Lawrence Seaway. It is 500 miles from New York and 370 miles from Chicago. Nearby will be one of the Nation's major crossroads where the Ohio Turnpike will intersect with the North–South Freeway now under construction, thereby tying together at this point the important New York, Pennsylvania, and Indiana Turnpikes and other major highways to all parts of the Nation. Major airlines, railroads, and bus lines serve the area. Akron is one of the largest trucking centers in the United States.

Situated on the high ridge separating the Great Lakes from the Mississippi Valley near the famous Indian Portage that once was the boundry of young America by treaty with the Indians, Akron owes its beginning in 1825 to the Ohio Canal. Early industrial enterprise established it as a center for the production of stoneware and pottery, farm machinery, and processed cereals.

Rubber came to Akron in 1870 in the manufacture of fire hose and grew to be Akron's primary industry and to make it the center of tire-making in the 1920's. Intensive research programs coupled with its diverse industrial history makes the Akron area prominent nationally today as a producer of plastics and synthetic rubber, chemicals, machinery, salt, matches, marine boilers, fishing tackle, and comic books as well as aircraft, nuclear and space-age devices components, systems, and controls.

Because of the extensive research facilities and the unusually large groups of scientists and technologists who live in and near Akron, the professional societies for these engineers, chemists, and others are vigorous and flourishing organizations.

"Early Bird" Reception

On Tuesday, April 21, from 8 p.m. to 10 p.m., an "Early Bird" Reception will be held in the Ohio Room, second floor, Sheraton Hotel, for early arrivals and their wives.

General Session

The General Session will be held in the Main Ballroom of the Sheraton Hotel at 2 p.m. on Wednesday, April 22. C. H. Linder, vice-president of engineering for the General Electric Company (GE) will be the main speaker.

Mr. Linder is a graduate of the University of Texas with a bachelor's and master's degree in electrical engineering. He joined GE in 1924 and after a variety of assignments became general manager of the company's activities in the large appliance field. He became a vice-president in 1953. As vice-president, engineering, his principal concern now is the effective direction of effort and use of resources in engineering throughout GE. An important segment of his activities centers on scientific and technological relationships within GE and between it and other business, governmental, and educational organizations. He is deeply interested in world-wide progress in science and technology and in establishing and maintaining successful working relationships with scientists and engineers in other countries.

Hotel Reservations

The facilities of the Sheraton Hotel have been reserved for the AIEE members for this meeting. Requests for room reservations should be made directly to the hotel. Reservations should be made as far in advance as possible. In the event of an overflow, the Sheraton Hotel will arrange reservations at another hotel or motel.

All rooms are with shower or combination tub and shower. Rates are as follows:

Single Room	$6.50, $7.50, $8.85, $10.85
Double Room	$10.00, $11.00, $12.35, $14.85
Twin Beds	$14.85, $16.00, $18.00
Dormitory Room	4 or more persons, $3.75 up per person.

Suite rate on request.

Student Paper Competition

The District No. 11 Prize Paper Contest will be held on Thursday, April 23, in parlor C, 9 a.m. to 12 noon and 2 p.m. to 5 p.m. The winning papers from the 15 Student Branches within the District will be presented and prizes awarded. The first prize is $25 and a trip to the Summer General Meeting at Seattle, Wash.; second prize is $25; third prize, $15. All members are invited to attend all or any part of the competition.

Registration

The Registration Desk will be on the second floor of the Sheraton Hotel. It will be open 8 to 10 p.m., Tuesday, April 21, and daily thereafter 8 a.m. to 5 p.m. Advance registrations are encouraged. All fees for social functions and inspection trips will be collected upon registration. Registration fees will be $3 for members, $5 for nonmembers. There is no charge for students and families of members.

Banquet

A banquet for all members, wives, and guests will be held in the Ballroom of the Hotel Sheraton at 7 p.m. on Thursday, April 23. D. C. Romick, head of the Astronautics Section of the weapons systems department of Goodyear Aircraft Corp., will speak on "The Dawn of the Age of Space Flight."

Dr. Romick, who is responsible for current astronautical applications and long-range project investigation, has gained a world reputation as an authority on rockets and space travel. His concept of a space ship is one of the few which are considered feasible. His illustrated lecture will paint a comprehensive and authentic picture of the development of space flight. The objectives and value of space flight to mankind will be outlined and the status of progress toward its achievement summarized.

He will discuss the physical well-being of space travelers; the orbital principles upon which space flight will operate; the devices and methods which will be used to set up and use a system of space travel and the cost and time required for such a program.

Dessert entertainment will be provided by the Akron Chapter Chorus and selected quartets of SPEBQSA.

Ladies Activities

Reception for early arrivals, 8 p.m. to 10 p.m. Tuesday, April 21, in the Ohio Room.

Hospitality Room for visiting ladies, open from 9 a.m. on Wednesday, Thursday, and Friday.

Wednesday at 12:30, a luncheon ($2) for the ladies, with casual modeling of spring fashions, followed by bridge if desired, at M. O'Neil Company's Georgian Room.

Wednesday evening, ladies are welcome on inspection trip to Ohio Brass Company ($1).

Thursday, 12 noon, luncheon ($2.50) at Fairlawn Country Club.

Thursday, 2 p.m., visit ($1.25) to Stan Hywet Hall and Gardens. This 38-acre estate and main house of 65 rooms represents one of the finest examples of English Tudor Revival architecture in the United States. Stan Hywet (pronounced "hee-wet") was built 1911-1915 by the late Frank A. Seiberling, founder of the Goodyear and Seiberling Rubber Companies. It and its gardens are a memorial to England's great Elizabethan period, a monument to America's period of great wealth.

It is noteworthy for its great hall, music room, Gobelin tapestries, rare porcelains, antiques and art treasures of the 17th and 18th Centuries. As intended by its builder whose home it was, it continues to serve today as a cultural center for the City of Akron.

Thursday, 6 p.m., cocktail hour.

Thursday, 7 p.m., banquet (men $6.50, ladies $5.50).

Inspection Trips

Seven inspection trips have been planned. Tickets, required for each trip, may be had at the Registration Desk.

Ohio Brass Company, Barberton, Ohio (Wednesday, April 22, bus from hotel at 7:20 p.m.) Ladies are especially invited to witness this demonstration showing spectacular ionization and corona phenomena. The explosive force of the high-voltage discharges makes one realize the magnitude of the problems encountered in building reliable insulators, arrestors, and bushings ($1).

Goodyear Tire & Rubber Company—Goodyear Hall and Plant No. 2 (Thursday, April 23, bus from hotel at 9 a.m.) The Goodyear trip will include the Rubber Exhibit and processing of rubber compounds and fabrics from raw materials to finished products.

The Rubber Exhibit dramatizes the history of rubber from the discovery of vulcanization to the present day. At Plant No. 1 will be seen the mixing of rubber compounds and processing to tire fabric through the most modern machines. Inspection of one of the high-voltage motor control rooms will be of special interest to electrical engineers.

At Plant No. 2, the visitors will observe the building and curing of tires and modern automatic tire machines and curing processes.

The manufacture of industrial rubber products including large conveyor belts, automobile floor mats, and flooring will also be included in this tour ($1).

Chrysler Corporation—Stamping Plant, Twinsburg, Ohio (Thursday, April 23, bus from hotel, 8:30 a.m.) One of the largest stamping plants in the world, both in over-all floor space and in production capacity. Completed in 1958, it is also one of the most modern. It has a floor space of 34 acres all under one roof and 28 major press lines stamp out major auto body components of all sizes including doors, quarter panels, deck lids, roofs, instrument panels, etc. The electrical system consists of a main substation of 37,500-kva capacity stepping power down from 138 kv to 13.8 kv. The 13.8-kv system distributes power about the plant to 9 double-ended substations, 11 single-ended substations having a total transformer capacity of 46,500 kva. Besides large motor and welding loads, utilization equipment includes 5,927 fluorescent light fixtures, 18 motor control centers, 1,344 1,000-watt mercury vapor lights, 426 miles of building control wiring, and 4.6 miles of 15,000 volt primary cable ($2).

Ohio Edison Company—345-Kv Test Line, Louisville, Ohio (Thursday, April 23, bus from hotel, 1:15 p.m.) Ohio Edison Company is conducting tests on a one-mile section of 345-kv line near Louisville, Ohio. These tests include continuous monitoring of wind and weather conditions and their effects upon various component parts of line, including conductors, towers, hardware, and other accessories. This monitoring is performed with the aid of a special laboratory built by the Preformed Line Products Company of Cleveland. It is housed in a trailer which provides living quarters for four technicians so that personnel are available to observe and record the effects of unusual weather conditions. Tests also are being conducted to simulate icing conditions and broken conductors. These tests made over a one-year period are expected to provide not only worthwhile design data but also valuable performance data on various component parts of line ($2).

B. F. Goodrich Research Center, Brecksville, Ohio (Thursday, April 23, bus from hotel, 1:15 p.m.) A large modern streamlined workshop of science. Chemical and physical research on synthetic rubbers, plastics, rubber chemicals, adhesives, textiles, insulating materials. Outstanding equipment includes a latest model electron microscope, two mass spectrometers, a cobalt-60 source of radiation, and a solar furnace. A feature of the tour will be a platform show demonstrating some new polymeric insulating materials ($2).

Firestone Research, Akron, Ohio (Friday, April 24, bus from hotel, 9 a.m.) A conducted tour of the company's chemical and physical research laboratories, including a discussion period under the leadership of Dr. J. W. Liska, assistant director of the company's chemical and physical research. A 15-minute film on tire distortion at high speeds will be shown following the laboratory tour. This film demonstrates the precautions which must be taken in rubber compounding and tire construction to maintain highway safety under the stress and strain of high-speed driving ($1).

Columbia-Southern Chemical Corp., Barberton, Ohio (Friday, April 24, bus from hotel, 9 a.m.) Columbia-Southern Chemical Corporation is one of the nation's leaders in the production of industrial chemicals. It operates its own limestone mine, sand plant, and salt wells to provide raw materials for operations, and maintains a large fleet of tank cars and river barges.

Columbia-Southern generates a major portion of its power requirements. The generation phase of its industrial power operations produces and distributes enough power to serve the needs of a medium size city.

In addition to seeing the operation of a large chemical processing plant, those taking the tour will see the following electrical installations: (1) generator facilities; (2) steam production facilities; (3) rectifier installation featuring D-C mercury arc rectifiers with capacity of 35,000 kw; (4) experimental high-voltage silicon rectifiers with capacity of 500 kw; (5) completely automated chemical production plants where industrial process controls are present.

Committee Meetings

Wednesday, April 22

8:30 a.m. District Executive Committee—Parlor B
1:30 p.m. District Executive Committee Luncheon—Parlor C

Thursday, April 23

9:00 a.m. National Executive Committee—Parlor B
12:00 Noon National Executive Committee Luncheon—Parlor B
2:00 p.m. National Executive Committee—Parlor B

Friday, April 24

12:00 Noon Rubber and Plastics Subcommittee Luncheon—Parlor C

OHIO BRASS COMPANY'S demonstration of the effects of high voltage will be one of the highlights of the East Central District Meeting's program of inspection trips.

Tickets

Tickets for all events will be available at the Registration Desk, second floor, Hotel Sheraton, open 8 p.m. Tuesday, April 21, and daily during the meetings from 8:30 a.m. to 5 p.m. Delegates are urged to secure tickets for events they wish to attend as early as possible since transportation arrangements will depend upon tickets sold.

Committee Chairmen

Members of the East Central District Committee are: W. H. Sammis, chairman; R. J. Feeney, vice-chairman; C. H. Fleming, assistant chairman; F. C. Timberman, secretary; E. A. Rothfus, technical papers; J. M. Sheadel, inspection trips; K. L. Boyer, finance; C. H. Golke, hotel arrangements; G. N. Himes, publicity; K. F. Sibila, students; E. L. Smith, chairman, Rubber and Plastics Subcommittee, chairman, Akron Section; Mr. and Mrs. J. E. Rose, social activities; H. R. Kronenberger, registration; R. J. Myers, transportation.

Mailed Announcement

A mailed announcement of this meeting will be sent to members in District No. 11. If a copy is desired by members in other Districts, please write to E. C. Day, Assistant Secretary for Technical Papers and Programs, TOD, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

Technical Program

The tentative technical program for the District Meeting follows.

Wednesday, April 22

9:00 a.m. High-Voltage Cables

Room: Sheraton Room

Chairman: T. F. Brandt, Ohio Brass Company

DP* The History of High-Voltage Cable. *E. J. Merrell*, Phelps Dodge Copper Products Corp.

DP* The Co-operative Effort of Manufacturers, Educational Institutions, and Power Utilities, in the Development and Test of Extrahigh-Voltage Cable Systems. *L. I. Komives*, Detroit Edison Company

DP* Manufacturer's Viewpoint on the Production of High-Voltage Cable. *E. D. Eich*, Anaconda Wire & Cable Company

9:00 a.m. Computers

Room: Parlor E

Chairman: V. R. Lalli, Thompson Products Company

DP* A Four-Axis Numerical Contouring Control. *P. H. McCarrell*, Thompson Ramo Wooldridge, Inc.

DP* Some Applications Involving Convolution Integrals and Their Solution. *Dr. F. E. Brammer*, Case Institute of Technology

DP* Research in Computer Programming. *Prof. R. J. Nelson*, Case Computing Center

*District Papers will not be printed by the Institute; however, they may be available at the meeting at the discretion of the author.

Thursday, April 23

9:00 a.m. High-Voltage Transmission

Room: Sheraton Room

Chairman: A. D. Lantz, Ohio Brass Company

DP* Tapered Tubular Steel Transmission Structures. *W. G. Anderson*, Union Metal Manufacturing Company

DP* Bundle Conductor Fault Current Tests—Tidd-Muskingum 345-Kv Line. *C. R. Rawlins, D. H. Sandell*, Aluminum Company of America

DP59-562 345-Kv Transmission Line Field and Laboratory Testing. *C. R. Bond, P. A. Fetterolf*, Ohio Edison Company

9:00 a.m. Rotating Machinery

Room: Parlor E

Chairman: C. G. Veniott, Reliance Electric and Engineering Co.

DP* Measurement of Rapidly Changing Temperatures. *J. E. Shea*, Underwriters Laboratories, Inc.

DP* Application Problems in the Measurement of Motor Winding Temperatures. *C. E. Green, T. Spink, Jr., D. Vandeventer*, Leeds & Northrop Company

DP58-1393 Start Winding Temperature Measurement of Fractional Horsepower Motors. *R. E. Seely*, General Electric Company

DP* Temperature Measurement of Fractional Horsepower Motors. *W. R. VanDyke*, Westinghouse Electric Corporation

CP58-1278 Temperature Measurement of Motor Windings on Stalled Rotor. *V. G. Vaughan, A. P. White*, Metals & Control Corporation

2:00 p.m. Electrical Drive Equipment

Room: Parlor E

Chairman: L. E. Buess, General Electric Company

DP* Advantages of Rating Large Motors at 60 C Rise. *L. F. Hayne*, Allis-Chalmers Mfg. Company

DP* A-C Torque Motors for Steel Processing Lines. *L. M. Berkley*, Reliance Electric & Engineering Company

CP58-1200 Characteristics of Electrical Loads in a Cement Plant. *L. C. Pringle*, Hercules Cement Company

DP* Electric Drive Equipment for a Coal Loading Dock. *J. E. Oram*, General Electric Company

2:00 p.m. Industrial Heating

Room: Sheraton Room

Chairman: W. V. Taracuk, Firestone Tire & Rubber Company

58-1259 Load Characteristics of a Submerged Arc Silicon Smelting Furnace. *G. Grant III*, Dow Corning Corporation

DP* Forgings in Industry and New Induction Heating Applications. *J. Edwards, W. C. Ekin*, Westinghouse Electric Corporation

DP* Dielectric Heating. *C. Loper*, Allis-Chalmers Mfg. Company

Friday, April 24

9:00 a.m. Static Components

Room: Parlor E

Chairman: W. F. Gardner, Westinghouse Electric Corporation

DP* Techniques in the Application of Silicon Power Rectifiers. *Dr. R. D. Lynch*, Westinghouse Electric Corporation

DP* Rectifiers for General Industrial Power Applications. *W. E. Gutzwiller*, Allis-Chalmers Mfg. Company

DP* Thermo-Electric Application. *Dr. S. J. Angello*, Westinghouse Electric Corporation

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AIEE Order Department
33 West 39th Street,
New York 18, N.Y.

9:00 a.m. Industrial Lighting

Room: Shearton Room
Chairman: L. F. Kielsmeier, Ohio Edison Company

DP* New Concepts for Meeting Human Needs with Light. *Morgan Christensen*, General Electric Company

DP* Design and Application of a New High Frequency Power Source for Fluorescent Lighting. *W. H. Johnson*, Westinghouse Electric Corporation

DP* Lighting from the Industrial User's Viewpoint. *D. J. Rose*, Babcock & Wilcox Company

2:00 p.m. Relaying and Distribution

Room: Sheraton Room

Chairman: N. R. Monohan, Ohio Edison Company

DP* Protective Relaying for Utility Industrial Power System Electrical Interconnections. *S. P. Tomasek*, Columbus & Southern Ohio Electric Company

DP* Backup Protection with Distance Relays. *Stratman Cooke*, Toledo Edison Company

DP* Self-Regulating Distribution Transformer. *H. F. Naramore*, Line Material Company.

2:00 p.m. Automation

Room: Parlor E

Chairman: P. S. Bechtol, B. F. Goodrich Company

DP* Effective Design for Automation and Its Personnel. *F. T. Parkes*, Thompson-Ramo-Woolridge, Inc.

DP* The New B. F. Goodrich Semiautomatic Individual Tire Building Machine. *H. G. Shively*, B. F. Goodrich Company

DP* Automation in Industry. *N. K. Conrad*, Ford Motor Company

Rubber and Plastics Conference

The tentative technical program of Rubber and Plastics Conference sessions follows.

Wednesday, April 22

9:00 a.m. Nylon Tire Cord Processing Session

Room: Ballroom

Chairman: N. A. Williams, Goodyear Tire & Rubber Company

DP* Preparation and Processing of Nylon

AIEE Future Meetings

Textile Industry Conference*
Heart of Atlanta Motel
Atlanta, Ga.
April 2-3, 1959

EJC Nuclear Congress*
Municipal Auditorium
Cleveland, Ohio
April 5-10, 1959

AIEE-AWS Electric Welding Conference*
Hotel Sherman
Chicago, Ill.
April 6-10, 1959

AIEE-ASME Railroad Conference*
Hotel Sheraton
Chicago, Ill.
April 8-9 1959

Southern District Meeting*
Dinkler Plaza Hotel
Atlanta, Ga.
April 8-10, 1959

Material Handling Conference*
Pfister Hotel
Milwaukee, Wis.
April 14-15, 1959

Electric Heating Conference*
Bellevue-Stratford Hotel
Philadelphia, Pa.
April 14-15, 1959

Electrical Problems in the Cement Industry Conference*
Americus Hotel
Allentown, Pa.
April 14-16 1959

Recording and Controlling Instrumentation Conference*
Bellevue-Stratford Hotel
Philadelphia, Pa.
April 20-21, 1959

East Central District Meeting*
Sheraton-Mayflower Hotel
Akron, Ohio
April 22-24, 1959

Rubber and Plastics Conference*
Sheraton-Malflower Hotel
Akron, Ohio
April 22-24, 1959

Empire District Meeting*
Hotel Syracuse
Syracuse, N. Y.
April 29-May 1, 1959

AIEE-IRE-EIA-WCEMA Joint Electronic Components Conference*
Benjamin Franklin Hotel
Philadelphia, Pa.
May 6-8, 1959

AIEE-ASME-IRE Automatic Techniques Conference*
Pick Congress Hotel
Chicago, Ill.
May 11-13, 1959

AIEE-University of Vermont Symposium on the Nuclear Power Plant
University of Vermont
Burlington, Vt.
May 14-15, 1959

Appliance Technical Conference*
Hotel Manger
Cleveland, Ohio
May 18-19, 1959

Middle Eastern District Meeting*
Lord Baltimore Hotel
Baltimore, Md.
May 19-21, 1959

AIEE-ISA-ARS-IAS National Telemetering Conference*
Brown Palace and Cosmopolitan Hotel
Denver, Colo.
May 24-27, 1959

International Conference on Information Processing
UNESCO House
Paris, France
June 15-20, 1959
(Exhibits June 13-22)

Paper and Pulp Conference
University of Maine
Orono, Maine
June 18-19, 1959
(Final date for †TP—closed, ‡CP Syn.—April 3, CPMs—April 14)

Summer and Pacific General Meeting
Olympic Hotel
Seattle, Wsh.
June 21-26, 1959
(Final date for †TP—closed, ‡CP Syn.—April 7, CPMs—April 17)

Air Transportation Conference
(at Summer General Meeting)
Olympic Hotel
Seattle, Wash.
June 22-26, 1959

Petroleum Industry Conference
Wilton Hotel
Long Beach, Calif.
August 23-26, 1959
(Final date for †TP—May 25, ‡CP Syn.—June 9, CPMs—June 19)

AIEE-ASME Engineering Management Conference
Statler Hotel
Los Angeles, Calif.
September 16-18, 1959
(Final date for †TP—June 18, ‡CP Syn.—July 3, CPMs—June 13)

AIEE-IRE Nonlinear Magnetics and Magnetic Amplifiers Conference
Shoreham Hotel
Washington, D. C.
September 23-25, 1959
(Final date for †TP—June 22, ‡CP Syn.—July 10, CPMs—July 20)

AIEE-ASME National Power Conference
Muehlebach Hotel
Kansas City, Mo.
September 27-October 1, 1959
(Final date for †TP—June 29, ‡CP Syn.—July 14, CPMs—July 24)

Fall General Meeting
Morrison Hotel
Chicago, Ill.
October 11-16, 1959
(Final date for †TP—June 12, ‡CP Syn.—July 30, CPMs—Aug. 7)

National Electronics Conference
Sherman Hotel
Chicago, Ill.
October 12-14, 1959
(Final date for †TP—July 14, ‡CP Syn.—July 28, CPMs—Aug. 7)

Machine Tools Conference
Hotel Cleveland
Cleveland, Ohio
October 19-21, 1959
(Final date for †TP—July 21, ‡CP Syn.—Aug. 4, CPMs—Aug. 14)

AIEE-IRE-ISA National Automatic Control Conference
Sheraton Hotel
Dallas, Tex.
November 4-6, 1959
(Final date for summaries—June 1)

Magnetism and Magnetic Materials Conference
Sheraton Cadillac Hotel
Detroit, Mich.
November 16-19, 1959
(Final date for †TP—Aug. 18, ‡CP Syn.—Sept. 1, CPMs—Sept. 11)

AIEE-IRE-ACM Eastern Joint Computer Conference
Statler Hotel
Boston, Mass.
November 30-December 3, 1959
(Final date for †TP—Sept. 1, ‡CP Syn.—Sept. 15, CPMs—Sept. 25)

*Final date for submitting papers—closed
†TP—Transactions Paper
‡CP Syn.—Conference Synopsis
CPMs—Conference Manuscript
DPMs—District Manuscript
(District Paper Synopses should be directed to the District Meeting Committee)

Transactions and conference papers must conform to the requirements in *Authors Guide*
For a copy, write to E. C. Day AIEE, 33 W. 39th St., New York 18, N.Y.

Tire Cord. *J. W. Bolymer*, E. I. du Pont de Nemours & Co. (Inc.)

DP* Nylon Treating Drives. *N. A. Williams*, Goodyear Tire & Rubber Company; *C. E. Robinson*, Reliance Electric & Engineering Company

Thursday, April 23

9:00 a.m. Calendering Session

Room: Ballroom

Chairman: F. E. Palmer, The General Tire & Rubber Company

DP* An Analysis of Calender Drives for Rubber Processing. *F. E. Palmer*, The General Tire & Rubber Company

DP* Windup Drives and Control. *A. V. Alexeff*, Industrial Ovens, Inc.

2:00 p.m. Static Components

Room: Ballroom

Chairman: R. D. Heyburn, The Firestone Tire & Rubber Company

DP* Semiconductors in the Rubber and Plastics Industry. *G. F. Muller*, General Electric Company

DP* Applying Magnetic Amplifiers. *J. B. Walker*, Gemco Electric Company

Friday, April 24

9:00 a.m. Plastics Extrusion

Room: Ballroom

Chairman: A. G. Seifried, The B. F. Goodrich Company

"Symposium on Heating for Plastics Extrusion"

DP* Induction Heating for Plastic Processing Machines. *W. J. Goodwin*, Hale & Kullgren, Inc.

DP* Heating for Plastics Extrusion. *T. C. Jones*, National Rubber Machinery Company

DP* Heating Problems of Plastics Extruders. *Robert Mansfield*, The B. F. Goodrich Company

DP* Application of Saturable Core Reactors to Injection Molding. *Glen Pettit*, Barber Coleman Company

Plastics Extruder Drive Characteristics. *G. D. Campbell, Jr.*, Reliance Electric & Engineering Company

2:00 p.m. Trends in New Machines and Processes

Room: Ballroom

Chairman: R. L. Hostetler, Adamson United Company

DP* Trends in New Machines and Processes. *H. P. Lamb*, Adamson United Company

DP* Aetna Automatic Mill. *R. C. Rogers*, Hale & Kullgren, Inc.

DP* Effects of Radiation on Elastimers and Plastics. *D. J. Harmon*, B. F. Goodrich Research Center

3:45 p.m. Rubber and Plastics Working Committee Reports

Room: Ballroom

Report of Working Group on Problems Due to Atmospheric Contamination. *J. C. Hall*, Goodyear Tire & Rubber Company

Report of Working Group on Standards for Rubber and Plastics Industries. *W. S. Watkins*, Ohio Rubber Company

AIEE Empire District Meeting
April 29—May 1, Syracuse N.Y.

THE AIEE Empire District Meeting will be held at the Hotel Syracuse, Syracuse, N. Y. on Wednesday, Thursday, and Friday, April 29, 30, and May 1, 1959. The theme of this meeting will be "New Horizons in Power and Industry."

Syracuse is located in the geographic center of New York State on Routes 5 and 20 and the New York State Thruway running East and West and on Route 11 running North and South. It is a thriving industrial center and numbers among its industries the General Electric Company's Electronic Park and other plants; Carrier Corp.; Brown Lipe Chapin Division of General Motors; Bristol Laboratories; Sylvania Electric Products, Inc.; Sanderson Halcomb Div., Crucible Steel Company of America; Pass & Seymour; Crouse Hinds Co.; Onondaga Pottery; Solvay Process Division, Allied Chemical Company, and many others. Syracuse, the home of Syracuse University and LeMoyne College, is also recognized as a prominent educational center.

The technical program for the meeting offers a wide variety of papers pertinent to electric utilities, industry, communications, electronics, computers, basic sciences, automation, and education for science and engineering. A Student Paper Contest, at which two students from each of the seven Branches in the Empire District will compete, will be held on Thursday afternoon, April 30. A number of interesting inspection trips have been planned and a program of entertainment for the ladies has been arranged.

Registration

Advance registration cards received in the mail should be filled out and returned promptly. This will save time in completing registration details upon arrival at the hotel and will permit the committee to make necessary arrangements for all inspection trips. The registration desk, located in the Main Lobby, 10th Floor, will be open on Wednesday and Thursday from 8:30 a.m. to 5:00 p.m. and on Friday from 8:30 a.m. to 12:00 noon. Registration fees are $3 for members and $5 for nonmembers. No fees will be required of student members or families of members.

Hotel Reservations

It is suggested that room reservations at the Hotel Syracuse be made promptly. Contact the Reservations Manager, Hotel Syracuse, mentioning AIEE, and advise him of the date and approximate time of arrival and the date of departure. The rates are as follows:

Single Rooms:	$ 7.00	$ 8.00	$ 9.00	$10.00	$11.00
Double Rooms:	$11.00	$12.00	$13.00	$14.00	
Rooms with Twin Beds:	$12.25	$12.75	$13.75	$14.50	$15.50
Parlor Suites: (Parlor, Bedroom and Bath)	$22.00 to $43.00				
Additional Bed (3rd Person)	$2.50				

All Rooms have bath.

General Meeting

The General Meeting will convene in the Grand Ballroom, East, at 9:15 a.m. The meeting will include a welcoming address by the Honorable A. A. Henninger, mayor, City of Syracuse. AIEE President L. F. Hickernell will speak on the work of AIEE in this age of progress.

General Luncheon

The General Luncheon will be held at 12:30 p.m. on Wednesday in the Grand Ballroom, West, 10th Floor. E. J. Machold, president of one of the country's largest Electric Utilities systems, the Niagara Mohawk Power Corp., will speak on, "A Public Utility Looks at the Future." Tickets for the luncheon are available at the registration desk. Price of the luncheon ticket is $3.

Smoker

A Smoker will be held in the Grand Ballroom, 10th Floor on Wednesday at 7:00 p.m. Excellent entertainment featuring nationally known George Bailey will be provided. Tickets will be available at the registration desk. Price of the Smoker ticket is $6.

Dinner Dance

Highlighting the social activities will be the Dinner Dance to be held in the Main Ballroom on Thursday evening, April 30, from 7:30 p.m. to 12:00 midnight. There will be dancing during and after dinner to an outstanding dance orchestra. Dinner will be served at tables of eight. Dress is optional. Tickets will be available at the registration desk. Price of the Dinner Dance ticket is $12 per couple, $7 for single persons.

A social hour, starting at 6:30 p.m., will precede the dinner dance. Cocktails will be served to all registered members courtesy of the Syracuse Section of AIEE and local Syracuse industries.

Ladies Program

The ladies headquarters will be in ladies Hospitality Room, Parlor F which will be open Wednesday and Thursday from 9:00 a.m. to 5:00 p.m. and on Friday from 9:00 a.m. to 12:00 noon. Registration for all ladies activities should be made in the Hospitality Room. The following ladies activities have been arranged.

Wednesday, 9:00 a.m.—rolls and coffee in Hospitality Room. 1:00 p.m.—informal luncheon at Persian Terrace, Hotel Syracuse. Afternoon free for shopping. 6:30 p.m.—Dinner at University Club (transportation provided) followed by Play Re-

Membership in the American Institute of Electrical Engineers, including a subscription to this publication, is open to most electrical engineers. Complete information as to the membership grades, qualifications, and fees may be obtained from Mr. N. S. Hibshman, Secretary, 33 West 39th Street, New York 18, N. Y.

view by Mary Aldrich Jones. Favors will be provided.

Thursday, 9:00 a.m.—rolls and coffee in Hospitality Room. 10:00 a.m.—tour of Onondaga Pottery makers of Syracuse China (transportation provided) souveniers will be furnished. 12:30 p.m.—luncheon at Drumlins Golf Club (transportation provided) followed by Card Party with table prizes. Thursday evening, delegates and their wives will attend the Social Hour and Dinner Dance in the Grand Ballroom.

Friday, 9:00 a. m.—rolls and coffee in Hospitality Room.

MILLIKEN STATION, New York State Electric & Gas Corp., will be visited during one of the inspection trips planned for the Empire District Meeting of the Institute, April 29-May 1, 1959, in Syracuse, N. Y.

Student Activities

The Student Prize Paper Competition will be held on Thursday afternoon at 2:30 p.m. Winners and runners-up of previously held Student Branch competitions participate. The winner will be awarded an expense paid trip to the Summer and Pacific General Meeting to be held in Seattle, Wash.

Student members are also invited to participate in all social events at reduced rates.

Inspection Trips

WSYR-TV Studios (Wednesday, April 29). This station, recently completed at a cost of over $2 million, represents the last word in television broadcasting studios. The largest upstate link of the National Broadcasting Company, it is powered at 100,000 watts visual, and 50,000 watts audio. The new station has three studios, each equipped with the latest in lighting controls, cameras, and facilities for live shows as well as connections to chain programs.

This station also has three radio studios and complete facilities for video tape recording. Busses will leave the Hotel at 1:30 p.m. Tickets are 50¢.

SAGE (Semi-Automatic Ground Environment) (Wednesday, April 29, and Thursday, April 30). This installation in Syracuse is the central control center for the air defense system of the Eastern Seaboard. This control center is connected to all radar observation centers in the United States, and Canada, the Civil Aeronautics Administration, Military Flight Centers, Navy Pickets Ships, Airborne Early Warning Aircraft, Texas Towers, and Air Weather Service Stations. In all, 13 major sources of information feed into this system. Under the jurisdiction of the 26th Air Division at Syracuse, this system is designed to protect the highly populated areas such as Boston, New York, Buffalo, Pittsburgh, Philadelphia, Baltimore, and Washington, in 14 states on the Eastern Seaboard. This area comprises 250,000 square miles and contains 45 million people. Advanced registration, by means of advance registration cards is required for this trip. Attendance is limited and preference will be given to earliest registrants and to out-of-town members. Buses will leave hotel at 2:00 p.m. Tickets are $1.

Sylvania Electric Products, Inc. (Thursday, April 30). This plant is one of the first installations of computers for use in a Data Processing Center. By the use of Remington Rand Univac computers, this company processes at its Camillus Center payrolls for 45 plants scattered from Maine to California, amounting to 23,000 paychecks per week, accounts payable, accounts receivable, and sales records. This system requires over 21,000 miles of leased telephone circuits. Advanced registration for this trip is recommended since attendance is limited. Preference will be given to out-of-town members. Bus will leave the hotel at 9:30 a.m. Tickets are $1.

Niagara Mohawk System Power Control Center, including Economic Dispatch Computer (Thursday, April 30). The recently completed Power Control Center for the Niagara Mohawk System represents the most modern facilities available for scheduling and dispatching of electric power. This center is the focal point for all utilities in the Northeast Interconnected System. Features of this center, which will be described during the Systems Engineering Session on Wednesday morning include system-wide telemetering equipment, the first installation of a direct-dial telephone system between all interconnected utilities, and the first installation of a multi-area Economic Dispatch Computer. Trips to this station will be made in groups of 15 starting at 1:30 p.m. Transportation will be available. Tickets are 50¢.

Milliken Station, New York State Electric & Gas Corp. (Friday, May 1). This is the newest steam plant of the New York State Electric & Gas Corp. It is located on Cayuga Lake about 17 miles north of Ithaca on the east side of the lake. This station has a generating capacity in two units of 310,000 kw and is a substantial part of the system generating capacity. The plant operates on a steam pressure of 1,850 psi at 1,000 F. This station is unique in that the generators are among the first to use forced hydrogen cooling of the wind ings through hollow conductors. The station is equipped with an automatic monitoring system. This performance data logging system is designed to digitally log and/or tape more than 80 items of performance data per hour in such form as to permit automatic conversion to punch card format for detailed performance analysis. Transportation will be arranged to leave the hotel at 9:00 a.m. Price of tickets will depend upon attendance and transportation methods selected.

Committees

Members of the Empire District No. 1 Meeting Committee are: General Chairman, Paul Kartluke; technical program, A. F. Paskevich; publicity, E. A. Gruppe; hotel arrangements, D. J. Williams; registration, C. E. H. vonSothen; printing and tickets, W. J. Helden; trips and transportation, J. B. Sullivan; student activities, E. V. Kosso; general luncheon and dinner dance, C. N. Palmer; smoker, J. W. Becker; ladies program, Mrs. H. C. Lindberg; Secretary, W. A. Bangs; Treasurer, R. W. Vollmer, Syracuse Section Chairman, J. W Munnis; District No. 1 Vice-President, L. C. Holmes.

Mailed Announcement

A mailed announcement of this meeting will be sent to members in District No. 1 and No. 12. If a copy is desired by members in other Districts, please write to E.

C. Day, Assistant Secretary for Technical Papers and Programs, TOD, American Institute of Electrical Engineers, 33 W. 39th St., New York 18, N. Y.

Technical Program

The tentative technical program for the District Meeting follows.

Wednesday, April 29

9:15 a.m. General Session—Grand Ballroom, East

Presiding: P. Kartluke, general chairman, District Meeting

Speakers: J. W. Munnis, chairman, Syracuse Section, AIEE
Honorable A. A. Henninger, mayor, City of Syracuse
L. C. Holmes, vice-president, Empire District No. 1, AIEE
L. F. Hickernell, president, AIEE

10:15 a.m. Substations—Parlors A & B

Presiding: L. F. McGowan, New York State Electric & Gas Corp.

58-1288 Preparation of Aluminum Conductors for Stable Electrical Connections. *M. R. Monashkin,* Burndy Corp.

CP58-1287 Evaluation of Two Basic Shapes of Conductor Grooves for Aluminum Power Connectors. *W. Frank, M. R. Monashkin,* Burndy Corp.

DP* Cast Aluminum Alloy for Power Connectors. *M. Brenner,* Penn Union Electric Corp.

10:15 a.m. Systems Engineering—Foyer

Presiding: L. K. Kirchmayer, General Electric Co.

58-1189 Some Applications of a New Approach to Loss Minimization in Electrical Utility Systems. *T. W. Sze, J. R. Garnett, J. F. Calvert,* University of Pittsburgh

DP* Niagara Mohawk System Power Control Center Features, Including Economic Dispatch Computer. *W. D. Wilder,* Niagara Mohawk Power Corp.

CP58-1282 New Load Dispatching Center for Philadelphia Electric Company. *W. H. Johnson,* Philadelphia Electric Co.

10:15 a.m. Industrial Power Systems—Parlor E

Presiding: T. O. Zittel, Bethlehem Steel Co.

58-1188 High Capacity Current Limiting Fuses Today. *E. M. Fitzgerald, V. N. Stewart,* General Electric Co.

CP58-1250 A Power System Designed for Reliability and Emergency Operation. *R. Loewe,* Argonne National Laboratory

CP59-244 Education and Maintenance in the Operation of Industrial Power Systems. *W. A. Weddendorf,* Mutual Boiler & Machinery Insurance Co.

12:30 p.m. General Luncheon—Grand Ballroom, West

Presiding: J. W. Munnis, chairman, Syracuse Section, AIEE

Speaker: E. J. Machold, president, Niagara Mohawk Power Corp.

2:30 p.m. Distribution—Foyer

Presiding: W. B. Kenyon, Rochester Gas & Electric Corp.

DP* Distribution, Secondary Conductor Economics. *A. S. Anderson,* Ebasco Services

58-1184 Report of a Survey on the Connection of Shunt Capacitor Banks. AIEE Capacitor Subcommittee of T & D Committee. *B. H. Schultz,* chairman, Line Material Co.

58-1295 Rural Distribution Planning. *E. H. Breckenfelder, C. M. Stanley,* Stanley Engineering Co.

2:30 p.m. Nuclear Power Plant—Parlors A & B

Presiding: M. H. Pratt, Niagara Mohawk Power Corp.

DP* Some Current Economic Aspects of Nuclear Power Development. *I. G. McChesney,* Rochester Gas & Electric Corp.

DP* Progress Toward Economical Nuclear Power with Boiling Water Reactors. *A. G. Mellor, J. B. McClure,* General Electric Co.

DP* Evaluation of the Initial Performance of the Shippingport Radioactive Waste Disposal Plant. *J. R. LaPointe, W. J. Hahn, E. D. Harvard,* Westinghouse Electric Corp.

DP* A Digital Startup Control for Air Cooled Nuclear Reactors. *S. Lehr,* General Electric Co.

2:30 p.m. Electronics, Communications—Parlor E

Presiding: E. J. Snow, General Electric Co.

DP* Radio Communication with Orthogonal Time Functions. *H. F. Harmuth,* General Electric Co.

58-1296 Supervisory Control for Air Force Missile Test Center. *C. L. Cadwell,* Westinghouse Electric Corp.

DP* Preparation, Transmission, and Distribution of Information in an Automatic Data Communication System Utilizing Telephone Facilities. *J. L. Wheeler,* Stromberg Carlson Co

Thursday, April 30

9:15 a.m. District Executive Committee Meeting—Parlor E

Presiding: L. C. Holmes, vice-president, Empire District No. 1

9:15 a.m. Education—Parlors A & B

Presiding: Prof. W. R. LePage, Syracuse University

Panel Discussion: "Trends in Education"
Prof. W. H. Erickson, Cornell University
Prof. H. W. Bibber, Union College
Prof. L. B Winsor, Rensselaer Polytechnic Institute
Prof G. W. Reed, Clarkson College of Technology

9:15 a.m. Niagara Power Project—Grand Ballroom, East

DP* Electrical Features of the Niagara Power Project. *J. S. Saloma,* Chas. T. Main, Inc.

DP* Design of High-Voltage Transmission System of Power Authority of State of New York. *R. E. Moran,* Uhl, Hall and Rich

DP* Pumped Storage—A New Power Source. *T. F. Armbruster,* Allis-Chalmers Manufacturing Co.

9:15 a.m. Lightning Protection and Switching Surges—Grand Ballroom, West

Presiding: O. K. Brown, Niagara Mohawk Power Corp.

58-1226 Application of Arresters for Complete Lightning Protection of Substations. *J. M. Clayton, R. W. Powell,* Westinghouse Electric Corp.

58-1170 Lightning Protective Requirements of Generators Connected to the System through y-Grounded-Delta Transformers. *J. K. Dillard, A. R. Hileman,* Westinghouse Electric Corp.

58-1160 Surge Transfer Through 3-Phase Transformers. *A. R. Hileman,* Westinghouse Electric Corp.

58-1178 Magnification of Switching Surges. *A. J. Schultz, I. B. Johnson, N. R. Schultz,* General Electric Co.

9:15 a.m. Electronic Circuits and Components—Foyer

Presiding: A. P. Stern, General Electric Co.

DP* A Transistorized Code Selector. *R. C. Clark,* General Electric Co.

59-563 Analysis and Design of Transistor Linear Delay Circuit. *R. P. Nanavati,* Syracuse University (Re-presented for discussion)

DP* Tubes and Transistors in Machine Control. *H. P. Grossman,* Concord Controls, Inc.

DP* Electronics in Automatic Control of Process Fluids. *P. H. Drinker,* The Foxboro Co.

12:30 p.m. Luncheon for District Executive Committee—Persian Terrace

2:00 p.m. Basic Sciences—Grand Ballroom, West

Presiding: M. G. Malti, Cornell University

DP* Dynamic Machine Theory. *H. K. Messerle,* University of Sydney

DP* Modifications of A-C Network Calculation with Phase Shift Representations. *L. B. Spencer,* Cornell University

DP59-564 Symmetrical Component Network Connections for the Solution of Phase Interchange Faults. *W. H. Ferguson,* Westinghouse Electric Corp.

DP* An Equation for Induction Motor Slip. *V. B. Honsinger,* Allis-Chalmers Manufacturing Co.

2:00 p.m. Extrahigh-Voltage Transmission—Grand Ballroom, East

Presiding: I. B. Johnson, General Electric Co.

DP* Research and Trends in Extrahigh-Voltage Transmission. *J. G. Anderson,* General Electric Co.

DP* The Effect of Higher Transmission Voltages on System Planning. *G. D. Breuer,* General Electric Co.

DP* Theory of Double Bridge Inverter for High-Voltage, D-C Transmission. *S. Linke,* Cornell University

DP* Planning Extrahigh-Voltage Cable Testing Procedures at Cornell. *J. L. Rosson,* Cornell University

DP* Present Status of the Extrahigh-Voltage Cable Test at Cornell. *G. Adams,* Niagara Mohawk Power Corp.

* District Papers will not be printed by the Institute; however, they may be available at the meeting at the discretion of the author.

2:00 p.m. Automation—Foyer

Presiding: H. L. Lindstrom, Westinghouse Electric Corp.

DP* Computer-Controller Practices in Industry. *W. Mikelson,* General Electric Co.

DP* The True Role of Numerical Control. *W. E. Brainard,* Kearney & Trecker Corp.

CP58-1230 A Method of Automatic Control of Car Retarders. *H. C. Kendall, J. H. Auer, Jr.,* General Railway Signal Co.

DP* On the Optimal Control of Chemical and Petroleum Processes. *Dr. E. Shapiro,* International Business Machines Corp.

DP* A New Approach to Analog Computer Scaling. *A. S. Jackson,* Cornell University

2:30 p.m. Student Prize Paper Competition —Parlors A and B

Presiding: Prof. E. V. Kosso, Syracuse University

Friday, May 1

9:15 a.m. Transformers—East Room, North

Presiding: G. M. Kallenbach, Niagara Mohawk Power Corp.

58-1169 Are Stabilizing Windings Necessary in All Y-Connected Transformers? *B. A. Cogbill,* General Electric Co.

DP* Choosing a Power Transformer. *L. W. Schoenig,* Allis-Chalmers Manufacturing Co.

DP* Planning Substations To Avoid Noise Complaints. *S. R. Lindgren,* Allis-Chalmers Manufacturing Co.

9:15 a.m. Industrial Control—Lobby Parlor

Presiding: C. H. Olney, Eastman Kodak Co.

DP* The Application of Reactor Control to Material Handling Equipment. *H. A. Zollinger.* Westinghouse Electric Corp.

CP59-84 Adjustable Speed Control of A-C Motors. *L. R. Foote,* General Electric Co.

DP* Industrial Applications of CYPAK. *G. Samios,* Westinghouse Electric Corp.

DP* Static Constant and Adjustable Voltage Power Supplies for D-C Shunt Motors. *E. H. Vedder, J. M. Cochran,* Westinghouse Electric Corp.

9:15 a.m. Communications—East Room, East

Presiding: R. C. Crawshaw, New York Telephone Co.

DP* Fundamental Planning for a Controlled Switching Point in the Nation-wide Telephone Dialing Network. *F. A. Moore,* New York Telephone Co.

DP* Trunking Facilities for a Controlled Switching Point in the Nation-wide Dialing Network. *B. A. Connolly,* New York Telephone Co.

DP* Switching Facilities for a Controlled Switching Point in the Nation-wide Telephone Dialing Network. *S. L. Calderwood,* New York Telephone Co.

DP* Routing a Call through Finished Controlled Switching Point in the Nation-wide Dialing Network. *W. M. Ott,* New York Telephone Co.

AIEE Winter General Meeting in New York Sets Attendance Record

THE AIEE Winter General Meeting, held in New York, N. Y., February 1-6, 1959, broke all previous attendance records and featured the largest number of technical sessions ever held at an Institute meeting. The facilities of three hotels—Sheraton (headquarters), McAlpin, and the Governor Clinton were utilized. Total attendance of members and guests reached 6,545, which exceeded the previous high of 5,340 set at the Winter General Meeting in 1958. There were 607 papers read at 140 technical sessions.

Inspection Trips

As part of the over-all program, the New York Section arranged a schedule of inspection trips of both technical and general interest. These included visits to the Radio City Music Hall, New York, N. Y.; Western Electric Company, Kearny, N. J.; United Nations General Assembly, New York, N. Y.; New York Times newspaper plant, New York, N. Y.; Bell Telephone Laboratories, Murray Hill, N. J.; the Astoria Generating Station, Consolidated Edison Company, Inc., New York, N. Y.; and Leeds & Northrup, North Wales, Pa. In addition, a smoker and dinner-dance were held and an interesting social program for the ladies was arranged.

General Session

R. T. Weil, Jr., chairman of the Winter General Meeting, opened the General Session with a warm message of welcome. He introduced AIEE President L. F. Hickernell who spoke on the AIEE's role in research over the past 75 years. He noted the contributions of the Institute to research provided by its facilities for presentation and discussion of papers and their subsequent publication in a permanent record covering the 75 years of the Institute's history. President Hicknernell stressed the vitality of the AIEE on its 75th Anniversary, a vitality embodied in the anniversary theme "75 Years—A Prologue to the Future." The president's speech appears on pp. 292 of this issue.

Prize Awards

W. R. Harris, chairman, Prize Awards Committee, presented the Institute Prize Paper Awards to a group of engineers whose technical papers were judged outstanding during the past year. The prize recipients were:

Communications Division. First Prize: M. B. McDavitt, Bell Telephone Laboratories, "6,000 Megacycle-per-second Radio Relay System for Broad Band Long-Haul Service in the Bell System." Second Prize: W. W. Peterson, International Business Machines Corporation, "An Experimental Study of a Binary Code."

General Applications Division. First Prize: L. V. Boffi, V. B. Haas, Massachusetts Institute of Technology, "Analog Computer Representation of Alternators for Parallel Operation."

Industry Division. First Prize: H. P. Fullerton, General Electric Company, and J. Teno, Lehigh University, Bethlehem, Pa., "A Mathematical Model and Procedure for Arc-Back Current Calculations for Power Rectifiers." Second Prize: I. K. Dortort, I-T-E Circuit Breaker Co., "Super-Position Applied to Mechanical Rectifier Contacts." Third Prize: A. Schmidt, General Electric Company, Lynchburg, Va., "Power Factor of Rectifiers."

Instrumentation Division. First Prize: F. A. Fisher, General Electric Company,

Courtesy Ross Photos

AIEE MEMBERS gather for informal discussions between sessions of the Winter General Meeting held at the Statler Hotel, New York, N. Y., February 1-6, 1959. In the middle of the lobby is a model of the new United Engineering Center.

"Transient Response of Impulse Voltage Dividers." Second Prize: E. E. Lynch, D. P. Waite, General Electric Company, "Steam Generator Instrumentation for a Nuclear Power Plant with Analog Computer Verification of Dynamic Action."

Power Division. First Prize: L. H. Fink, J. J. Smerke II, "Control of Thermal Environment of Buried Cable Systems—Part II." Second Prize: W. K. Sonnemann, C. L. Wagner, and G. D. Rockefeller, Westinghouse Electric Corporation, "Magnetizing Inrush Phenomena in Transformer Banks."

Science and Electronics Division. First Prize: D. W. Kitchin, O. S. Pratt, Simplex Wire & Cable Co., "Treeing in Polyethylene as a Prelude to Breakdown." Second Prize: I. K. Dortort, I-T-E Circuit Breaker Co., "Current Balancing Reactors for Semiconductor Rectifiers." Third Prize: H. Hellerman, Syracuse University, "A Generalized Theory of Transistor Bias Circuits." Fourth Prize: E. A. Sack, Westinghouse Electric Corporation, "An Electroluminescent Digital Indicator with ELPAK Translating Logic."

Student Division. C. MacDonald, Nutley, N. J., "A Slow-Scan TV System for Image Transmission." Second Prize: D. B. Ulm, Salem, Mass., and M. Hurlbut, Erie Pa., "Effects of Phase Shift between Voltages of a Magnetic Amplifier.

E. W. Engstrom, executive vice-president of the Radio Corporation of America received an award for the best article appearing in Electrical Engineering during the past year. The article, "Science and Technology in a Changing Environment," appeared in the April 1958 issue of *Electrical Engineering*, p. 283-87.

The report of the Nominating Committee was given by its chairman. W. J. Barrett. Nominees are listed on p. 384.

Highlights of the General Session were the presentation of the Alfred Noble prize to Dr. Ghaffar Farman-Farmaian of Tehran, Iran, by F. S. Friel, president, American Society of Civil Engineers (ASCE); and the presentation of the Electrical Engineering Medal to J. F. Calvert, head department of electrical engineering, University of Pittsburgh, Pittsburgh, Pa. The medal presentation including the response of the recipient is found on pp. 346-49 of this issue. Dr. C. F. Kettering, noted inventor, engineer, and industrialist was awarded the Edison Medal for 1958 posthumously. Presentation was made by E. B. Robertson, chairman, Edison Medal Committee.

The keynote address was made by J. R. Killian, chairman of the corporation, Massachusetts Institute of Technology, and chairman, President's Science Advisory Committee. His address appears on p. 298 of this issue.

Technical Sessions

Russian Education and Technology. This session was sponsored by the Basic Sciences and Education Committees. Prof. W. W. Brickman, New York University, who recently returned from the Soviet Union, spoke of the tendency to overestimate the Soviet educational system on the part of some American leaders who have "thrown wisdom to the winds and scientific method to the dogs." He pointed out in his paper 'My Experience in the Soviet Educational System," that American leaders have tended to overrate the foreign-language training program of the Soviet schools, overlooked the overlarge classes and the multiple sessions, and have not taken proper cognizance of the underpaid teachers in the lower grades. It was emphasized that it was most difficult to evaluate the Soviet school system before knowing that system with thoroughness and being able to evaluate it in terms of its own aims and those of the world in which we live.

R. K. Honaman, director of publications, Bell Telephone Laboratories, Inc., spoke on the strides made by the Soviet Union in disseminating technical information. He cautioned that awareness of these strides must not be used as a tool to stampede the United States into accepting a plan in this country which does not meet our needs.

Symposium on Conductor Vibration. A mobile instrumentation system for accumulating and recording quantitative data in field studies of vibration of overhead transmission lines has been constructed and its functional operation established. This was reported by J. R. Ruhlman, J. C. Poffenberger, and S. Grosshandler of Preformed Line Products Co., Cleveland, Ohio. The transportable unit is called "Dynalab" which can also be used as an instrumentation medium in other types of studies concerned with dynamic phenomena and stress determination such as field tests of transmission structures or investigations involving the vibration characteristics of generators, turbines, and other rotating machinery. "Dynalab" is being used to facilitate a long term program of closely co-ordinated field and laboratory experimentation on overhead line vibration problems. Telemetering systems are being employed in the mobile unit and show great promise of being an entirely practical solution to the difficult problem of securing accurate physical data from energized lines.

M. B. Elton, Bonneville Power Administration; A. R. Hard, Washington State College; and A. N. Shealy, Kaiser Alumi-

Courtesy Ross Photos

Courtesy Ross Photos

A SCROLL is presented (above, *left*) to E. W. Engstrom (*left*), senior executive vice-president of the Radio Corporation of America, New York, N.Y., for the best article on electrical engineering written during the year 1958. The presentation was made at the general session of the Winter General Meeting of the Institute by L. F. Hickernell (*right*), president of the Institute. Above, right: R. T. Weil, Jr. (*left*), chairman of the Winter General Meeting, inscribes attendance figure on chart during the final hours of the 5-day get together in the Statler-Hilton. Final attendance was 6,545, a new record, topping 1958 by more than 1,000. Looking on is T. C. Oliver, chairman, Registration Committee.

num & Chemical Corp., reported, in their paper "Transmission Conductor Vibration Tests", that extensive laboratory and field vibration tests of transmission conductors and steel towers in power systems during the past 9 years have brought forth a wealth of information resulting in substantial savings. Other papers were "Progress Toward Optimum Damping of Transmission Conductors," J. E. Sproule, A. T. Edwards, Hydro Electric Power Commission of Ontario, Canada; and "Improved Systems for Recording Conductor Vibration," C. B. Rawlins, J. R. Harvey, Aluminum Company of America.

Video Tape Facilities and Television Antennas. D. M. Taylor, Radio Corporation of America, described a video automatic gain control that helps the operator in broadcast stations "ride" gain at the camera control position. Automatic gain control is necessary inasmuch as the operator has a limited reaction time that tends to permit the video levels to get out of control. The author emphasized that this automatic device should be used as an adjunct to the operator and not as a device to replace the generator.

K. B. Benson and P. E. Fish described the "CBS New York Video Tape Facilities" which the CBS network inaugurated in the spring of 1958. These facilities provided service, during the ensuing daylight-saving period, to 98 stations of the CBS television network. The paper relates the background which led to the need for these facilities, and describes the technical and operational features of the installation.

Telegraph Systems. A very important role will be assigned to teleprinters in the forthcoming age of automation, H. Wusteney of Siemens & Halske AG, Munich, Germany, reported in his paper "Properties of Modern Teleprinters with Regard to Signal Transmission." Today, the author said, the large majority of all teleprinters are installed in the premises of private customers and not in the telegraph offices. These machines are intended for direct record communications between the various offices of the same or different companies or governmental agencies and their place is at the side of the office typewriter. In the future, the control of manufacturing processes, the inter-operation with computers and with similar equipment for transmission of data will, in addition to the present exchange of messages, assume a very important role. The author described a new page printer designed by his company.

C. H. Stewart II, Bell and Gossett Co., in his paper, "A Nonsynchronous System for Mobile Record Communications," gave a description of a completely nonsynchronous transmission system which solves the problem of handling data at high transmission rates over a mobile extension to a printing telegraph network.

System Engineering. R. N. Brudenell and J. H. Gilbreath in their paper "Economic Complementary Operation of Hydro-Storage and Steam Power in the Integrated TVA System," discuss the economic integration of the hydro and steam plants in delivering the required bulk power to the high-voltage transmission system. The paper treats the subject from the standpoint of the operation of an existing or determined system of plants. R. H. Kerr and L. K. Kirchmayer of General Electric Co. extend the theory and the co-ordination equations previously derived for optimum economy for a single area to obtain the co-ordination equations for optimum economic operation of a pool operated as a multiple-area system. Multiple-area operation of the pool is defined to be operation for which the interchanges between the areas are directly determined and controlled. The paper is titled "Theory of Economic Operation of Interconnected Areas."

Courtesy Ross Photos

DR. GHAFFAR FARMAN-FARMAIAN, a consulting engineer of Tehran, Iran, (second from left) was honored as the winner of the 1958 Alfred Noble Prize Paper Award given jointly by the AIEE and the American Society of Civil Engineers (ASCE) at Winter General Meeting of AIEE in New York, N.Y. To receive the award, which is given for the best technical paper written by an engineer under 31 years of age, the Iranian made a special trip to this country. Officials in the group with him are (left to right) F. E. Canavacial, professor of electrical engineering, Polytechnic Institute of Brooklyn; F. S. Friel, president of the ASCE, who awarded the scroll; and L. F. Hickernell, president of the Institute.

Communication Theory. L. S. Schwartz' paper "Marginal Utility and the Information Rate of Communication Systems" attempts to extend the concept of an economic value measure for communications under the condition of an interchange between the transmitter rate, determined by the number of integrations, and the reliability of the received messages. Moreover, the question of the optimum interchange is examined from the utility standpoint by means of D. Bernoulli's Law of Diminishing Marginal Utility.

Other papers read were "Asynchronous Multiplexing," J. E. Taylor, General Electric Company; "Detection, Perception and Psychophysics," E. C. Carterette, University of California; and "A Mechanized Radar Observer," G. P. Dineen, Massachusetts Institute of Technology.

Relays. "The Co-ordination and Testing of Protective Relays in Industrial Plants," T. L. Bourbonnais, II, E. I. du Pont de Nemours & Co., (Inc.), discusses the co-ordination and maintenance of protective relays as found in the widely dispersed industrial plants of one large chemical corporation. Co-ordination and relay maintenance conducted by engineers from a single central agency has proved technically and economically justified.

T. Karlsen and H. A. Wallhausen in their paper "A Device for Solving Mutual Induction Problems on a D-C Network Analyzer" describe a d-c voltage insertion device used by the Detroit Edison Company in conjunction with its d-c analyzers to solve mutual induction problems.

Electrical Insulation. L. J. Berberich's paper "Three Decades of Progress in Electrical Insulation," recounts the outstanding progress made in the field of electrical insulation over the last 30 years. These may be summarized as follows: (1) the refinement of the theories which has resulted in a better understanding of dielectric phenomena; (2) the development of an imposing array of new synthetic materials which have replaced many of the natural materials formerly used; (3) the development of a new philosophy of thermally rating insulating materials and systems of materials as they are used in electrical equipment; and (4) the application of the new materials in electrical equipment in a manner which often resulted in major advances in equipment designs both from an economic and performance standpoint.

A companion paper was "The Present Status and Anticipated Progress in the Field of Insulating Materials," T. D. Callinan, International Business Machines Corp.

Chemical Processes and Petroleum Industries. Reliable power has been a foremost need of the petroleum industry since its inception. Unlike many factories, petroleum process units cannot be inadvertently shut down without some risk of damage. J. C. Howard discusses this need

in his paper "The Development of Reliable Electrical Systems in Petroleum Refineries." This reliability of electric power has come a long way since the days of the pioneer electric lighting systems when oil lamps were kept close at hand for emergencies. The tremendous growth of the electric industry can be attributed largely to improvement in the reliability of service, and it is this type of service, the author points out, that makes possible the electric operation of large petroleum processing units.

Educational Television. A session devoted to the use of television as an important educational tool was held Monday morning. C. M. Braum of the Joint Committee on Educational Television reported on general progress which has been made to date in this fast-growing field.

A very extensive investigation on television in education is being conducted by the New York State Education Department. The greatest undertaking ever attempted in educational communications by one institution is taking place in Cortland County. This is a closed-circuit system, with independent pupil talkback provisions, in which eight schools in three school districts are tied in by means of coaxial cables. This system was described in three papers. The first, by F. E. Almstead of the New York State Education Department, covered its general aspects and its basic educational requirements. The technical aspects of the coaxial cable system were discussed in a paper by W. L. Wall of the New York Telephone Company. The third paper, by R. C. Norton and J. B. Davidson of the New York Telephone Company, described the independent talkback system.

Nuclear Power Plants. The Tuesday afternoon session on nuclear power plants featured three papers. A conference paper by V. V. Mason and S. M. Jones, Canadian Westinghouse Company, Ltd., described the Horizontal Pressure Tube Reactor, designed to meet the requirements of the Canadian nuclear power program. The reactor, which uses natural uranium and has a reasonably low capital cost, employs incremental bidirectional fueling in Zircalloy pressure tubes with pressurized heavy water as coolant.

R. E. Frick of Gilbert Associates, Inc., discussed auxiliary power systems for nuclear plants. The proposed scheme, using an auxiliary main shaft driven alternator, provides a reliable power source for reactor control and generator excitation. It provides isolation of vital equipment from system disturbances and the maximum amount of economic inertial energy obtainable for shutdown power.

A nuclear power plant simulator designed for the U. S. Maritime Administration to simulate the nuclear plant of the merchant ship *NS Savannah* was described by N. E. Bush of the Westinghouse Electric Corporation. The heart of the simulator is an electronic analog computer, which continually solves the mathematical equations which describe the reactor plant and its control system.

Training in Communications. Several papers devoted to training of engineers in industry were presented at a Wednesday morning session. C. E. Waldner of the New York Telephone Company pointed out the necessity for industry to take the initiative in training its people, particularly in the areas requiring specialized education. The New York Telephone Company's Communications Training Program, established at Cornell University in 1957, has been set up to provide the necessary training for 200 of the company's engineers. Under this program, each student attends three 3-week sessions spaced 4 to 6 months apart, with a maximum class size of 24 students.

The Southern Bell Telephone Company's training program at Clemson College was described in a paper by W. C. Burnett of Southern Bell Telephone and L. C. Adams of Clemson (see *Electrical Engineering*, January 1959, pp. 75-78).

The Telephone Engineering Management Conference was discussed by P. H. Henson of the Lincoln Telephone and Telegraph Company, Lincoln, Nebr. This conference, first held in 1957, has proved to be a valuable tool for increasing the effectiveness of engineering personnel in the telephone industry.

Courtesy Leeds & Northrup Co.

VISITORS from seven nations were among 26 members of the AIEE who toured the Leeds & Northrup Company (L&N) North Wales, Pa., plant on February 4, during the Winter General Meeting. G. F. Rucker (*pointing*) of L&N, explains operations of partly completed computer console for control of electric power from three generators. Listening are (*left to right*) W. McConnachie, group leader, U.S.; H. Jorquera, Chile; J. W. Yoh, Japan; H. Ruge, Norway; J. Hus, Canada; L. Lindblad, Sweden; and H. Wohlgemuth, Germany.

Auxiliaries. The AIEE Land Transportation Committee was the sponsor of a Thursday afternoon session on railroad auxiliaries. J. D. Hughson of General Railway Signal Company described a car accelerator for railroad classification yards. This is a small remotely controlled power unit which accelerates cars having poor rolling characteristics, thus facilitating "humping" operations.

A generating system developed for railroad cabooses was covered in a paper by L. B. Haddad, R. A. Vercella, and D. W. Brown, all of Safety Industries, Inc. The 15-volt 1.5-kw d-c generating system consists of a power transmission, an alternator, a rectifier, a battery, an adjustable voltage regulator, and means for overload protection. Certain design features have never before been offered in railroad service.

The session closed with a paper on improved d-c high-potential testing of insulation systems in low- and medium-voltage d-c equipment by A. M. Odok of the General Electric Company and T. M. Soelaiman of the University of Indonesia.

Magnetic Amplifiers. The subject of the first paper presented at a Friday morning session devoted to magnetic amplifiers was combined magnetic and electric feedbacks in amplifier circuits, as reported by L. A. Finzi, Carnegie Institute of Technology, and J. J. Suozzi, Bell Telephone Laboratories. A previous analysis of magnetic amplifiers modified by feedbacks has been extended to two combinations of magnetic and electric feedback, with particular reference to self-balancing operation.

C. E. Hardies of Magnetics, Inc., described the theory and circuitry of a device having a single magnetic storage core, used to produce long time delays. It can be employed in conjunction with static switching devices in performing the functions of logic for control purposes.

"Automatic Regulators with Self-Balancing Magnetic Amplifiers" by W. A. Geyger, U. S. Naval Ordnance Laboratory is concerned with the application of the self-balancing magnetic-amplifier technique to automatic regulators. Two examples described are a constant-voltage regulator with smoothed low-impedance d-c output for charging of special-type storage batteries, and a constant-light-intensity regulator with a barrier-layer-type photoelectric cell for instrumentation.

Industrial Control. A paper by H. C. Diener, Jr., Westinghouse Electric Corportation, on the application of shift register techniques to materials handling, opened a Friday afternoon session sponsored by the AIEE Industrial Committee. Techniques were described by means of which information can be moved through a control system in synchronism with material being transported in a materials handling system. Such information can determine where the materials can be unloaded or what processes are to be performed on it. (*Electrical Engineering*, January 1959, pp. 69-73.)

A procedure for simplifying and transforming any Boolean function without many of the restrictions encountered in previously presented procedures was outlined by R. L. Howard of Westinghouse.

Also presented was "Logic Design Techniques of Static Switching Control for

Transfer Machines," a conference paper by J. W. Stuart and R. A. Manning, both of Westinghouse. Because logic functions inherently offer a direct approach to control design and understanding, systematic design techniques based upon the use of static switching devices for the control system are outlined. To illustrate this approach, an automatic in-line transfer machine was chosen.

AIEE Board of Directors Holds Meeting February 6, 1959

ON THE LAST DAY of the 1959 Winter General Meeting, the Board of Directors held its customary midyear meeting. The agenda was, like the whole Winter Meeting program, heavy with items postponed because of the cancellation of the Fall General Meeting, in October 1958. The Board met last in August 1958 at the Pacific General Meeting in Sacramento, Calif. Attendance was 100%, plus several newly nominated Vice-Presidents who were available and interested in starting their indoctrination. The agenda covered many important routine matters characteristic of all Board meetings. Several actions, however, have special significance for all members.

Finances

The Treasurer and the Finance Committee reported that a decline of advertising revenue, commonly experienced by all technical magazines, together with a 23% increase in the number of pages of printed material turned out by the Technical Committees appears to be heading us for a deficit of $175,000 in the fiscal year's operations. The loss of revenues from the Fall Meeting accounts for $8,000 of the total. Other items of income and expenses are running on the favorable side. Dues income is well ahead of schedule.

New Constitution

The Board approved, for submission to the membership in April, a completely revised Constitution. The new streamlined document relegates many details of operation to the Bylaws. It regroups and numbers the remaining sections of the basic law of the Institute for easy reference and clearer understanding. Work on the new Constitution has been in progress for nearly 3 years under the guidance successively of E. S. Lammers, R. E. Kistler, and J. C. Woods.

Bylaws

The Board heard recommendations for making the rebate of Entrance and Transfer Fees and the expanded Section meeting bonus, which have been in effect on a temporary basis for the past 2 years, a part of the Bylaws. The amendment of Bylaw 65 to remove the prohibition against Joint Affiliate Branches was approved. Also of interest to Section officers will be the revision of Bylaw 46 calling for a more formal approach to the establishment of Subsections. This is now to be done by petition to the Section and approval by the District Representative of the Sections Committee, the Vice-President, and the Chairman of the Sections Committee; with due notification to the office of the Secretary of the Institute. The conditions for the termination of a Subsection are also clearly defined.

Plans are progressing toward the rearrangement of District territory in the interests of more equally dividing the administrative load among Vice-Presidents.

Intersociety Relations

A proposal for the merger of Engineers' Council for Professional Development (ECPD) and Engineers Joint Council (EJC) was received without recommendation from the Board of Directors of EJC. The same report was received from the Executive Committee of ECPD with the information that it had been recommended to the full Council of ECPD by a vote of 4 to 3. The AIEE Board found the report lacking in evidence that the claimed advantages would be achieved, or that the vital work of ECPD would not suffer from the superposition of organizational structure consisting of the renamed present EJC Corporation. The Board voted that it does "not favor" the proposed merger.

New Medals

The Board approved contracts with the Bell Telephone Laboratories and the Radio Corporation of America for the establishment of an AIEE Medal in Telecommunications, to be known as the Mervin J. Kelly Award; and one in the field of Electronics to be the David Sarnoff Award. The Professional Development and Recognition Department has been successful in the past two years in securing sponsorship for four out of the five fields selected as desirable for Institute recognition by awards for distinguished achievement.

Technical Operations

An agreement was reached with the Engineering Institute of Canada (EIC) for the exchange of technical papers. The arrangement works through the Technical Operations Department (TOD) of AIEE and the EIC Electrical Engineering Technical Division.

Dr. W. A. Lewis, who has been heading a Special Task Force on Institute Activities and Organization, presented a preliminary report to the Board. Seven steps are proposed for the modification of the AIEE structure, chiefly in the fields of technical operations and associated publications. One step calling for a "New Activities Committee" has already been adopted by the TOD as a means of identifying new areas of scientific and engineering development and organizing technical activities to serve AIEE members promptly.

General

Eight Fellows were elected. Their pictures and biographies will appear in a subsequent issue of *Electrical Engineering*.

The 1959 Annual Meeting date was set as Monday, June 22, 1959, in Seattle, Wash., as part of the 1959 Summer and Pacific General Meeting.

The next meeting of the Board of Directors will be held at the 1959 Summer Pacific General Meeting in Seattle on Friday, June 26, 1959. The Executive Committee will meet at the District No. 11 Meeting in Akron, Ohio, on April 23, to consider the 1959-60 budget and such other business as may require attention prior to the June Board meeting.

Maximum Length for Technical Papers Established by Publications Department

AN INCREASE OF 34% in the number of technical papers and conference papers accepted in the last few months and the number that were greatly in excess of a reasonable length has caused the Publications Department to devote attention to this serious matter.

The practices of other societies in regard to a maximum allowable length for technical papers were carefully studied and it was found that most societies have controls over the length of papers accepted. Therefore, the Publications Department has set as a maximum allowable length for all *Transactions* papers and preprinted conference papers, a 20-page pamphlet, which is the equivalent of 12,000 words, less 350 words for each illustration used, and less the equivalent space required for all tabular matter. This does not mean that all papers should approach a 12,000-word length; most of them should be a great deal shorter. However, arrangements will be made for special approval in rare exceptional cases of very essential papers requiring a longer length. Papers should be as concise as possible to present fully and clearly new and improved technical developments.

The maximum allowable length of a 20-page pamphlet is effective with all papers submitted after May 1, 1959.

AIEE Section Representatives and Member-Gifts Chairmen Meet in New York

THE HOTEL STATLER in New York City was the scene of an all-day meeting of AIEE Section Representatives and Member-Gifts Chairmen held February 3, 1959, during the Winter General Meeting of the Institute.

The meeting was called to order by the presiding officer, H. H. Sheppard, chairman of the AIEE Sections Committee and vice-chairman of the AIEE Member-Gifts Campaign Committee, who introduced, among others, W. E. Scholz, secretary of the Sections Committee as well as of the Member-Gifts Committee.

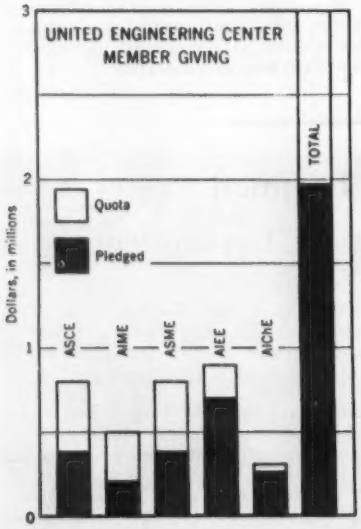
United Engineering Center

Prominent on the morning's agenda was a comprehensive review of the progress and problems related to the United Engineering Center.

W. J. Barrett, past president of the Institute, discussed the over-all status of the situation, including the positions the various contributing societes have reached in fund drives toward their quotas. He also projected several slides showing the site on United Nations Plaza, and architects renderings of the building itself.

Mr. Barrett was followed by W. F. Thompson, vice-president of United Engineerng Trustees, Inc. (UET) and chairman of the UET Real Estate Committee, who, in preliminary remarks, discussed the probable cost of the building, the necessity for and ways of reducing this cost, and the many advantages of the site chosen for it.

His report to AIEE on the activities of UET for the last 12 months included a description of physical details of the site and the building (*Electrical Engineering*, January 1959, p. 88) which is tentatively scheduled for completion in 1961. He also presented the background and achievements of the various fund raising drives—Member-Gifts Campaign, Industry Campaign, and Greater New York City Business Campaign.



THE BAR GRAPH shows the status of member giving as of February 13, 1959. All contributions to the UET building Fund are tax deductible.

Details of the AIEE Member-Gifts Campaign were given by L. M. Goldsmith, campaign chairman, and W. E. Scholz, secretary.

In his general remarks, Dr. Goldsmith mentioned the fact that large cities are doing a poor job in comparison with rural districts. He offered some suggestions to individual campaign leaders and encouraged them to strive toward not just reaching AIEE's quota, but topping it.

Mr. Scholz presented a detailed report of Section and District progress which included the following information:

As of February 1, AIEE pledges and contributions had reached a total of $654,185 or 72.7% of the Institute's quota of $900,000. The Sections now on the honor roll of the "100% Quota Club" are:

Section	Per Cent of Quota
Schenectady	145
Richland	121
Spokane	108
Pittsburgh	126
Dayton	179
Pittsfield	107
Virginia Mountain	103
Sharon	107
Corpus Christi	112
Sacramento	107
Oklahoma City	102
Lima	106
Mansfield	124
Erie	102
Illinois Valley	101
Boston	101
Rochester	101

Of these 17 Sections, 7 Sections have turned in their final reports, having contacted 100% of their members. In order, they are: Richland, Schenectady, Pittsfield, Mansfield, Erie, Sacramento, and Rochester.

Among AIEE Districts, District No. 1 is still holding first place having reached 89% of its quota. District No. 12 is still in second place with 76%. Third place goes to District No. 2 with 70% and in fourth place is District No. 11 with 57%.

Two more Sections have contributed to the campaign out of their Section funds: Lynn and Lehigh Valley. Another highlight: Lehigh University Student Branch was the first Student Branch to contribute to the Building Fund. The contributions from Section funds stand as follows: New York, $15,000; San Francisco, $1,000; Maryland, $1,000, and its Eastern Shore Division, $200, for a total of $1,200; Sacramento, $500; Los Angeles, $1,200; Boston, $1,140, and Ladies of the Boston Section, $108, for a total of $1,248; Lynn, $500; Lehigh Valley, $500, and Lehigh University Student Branch, $25, for a total of $525.

Following the report of Section and District progress, T. F. Thompson of the Florida West Coast Section presented a check for $1,500 from Section funds to the Member-Gifts Campaign.

Membership

L. F. Hickernell, President of AIEE, addressed the Section Representatives on the subject of "Membership Growth: A Major Section Problem."

In his talk, President Hickernell made the point that, "Insofar as rate of membership growth is concerned, the Institute is in a 'recession,' and has been since 1953." He then presented several slides which helped to illustrate this fact.

Slide 1 compared AIEE rate of membership growth with two yardsticks in the electrical industry: number of telephones and kwhr sales. From 1936 to 1953 (17 years), the Institute kept pace with these industries. Starting in 1953, there was a sharp change in the rate of growth.

The next slide presented the same membership data in detail. President Hickernell analyzed the data as follows: starting with a healthy 10% annual increase, from 1953 to 1957 the annual increase deteriorated to a lowly 1.2%. A slight upturn to 3.2% was experienced in 1958. Had the 1936-53 rate of growth been maintained, the AIEE would now have 65,000 instead of 52,000 members.

Slide 3 showed sources of income for the fiscal year 1957-58. The importance of membership was made evident by the fact that 51.8% of income is from dues.

The fourth slide indicated the amount of effort which would be required to regain the pre-1953 rate of growth of approximately 10% annually. To achieve this, at least 8,000 new members would be needed in 1958-59.

After presenting the problem, President Hickernell urged the individual Sections to analyze local conditions and to take whatever action would be most effective in attracting new members. To aid them in this endeavor, he offered a checklist of "avenues of exploration."

He concluded his address to the Section Representatives with the thought that "In a country as large as ours, membership increase cannot be accomplished by a central committee. While the problem is an Institute concern it is necessarily a Section responsibility. Just as the responsibilty is yours, so is the challenge."

Following President Hickernell, F. S. Black, chairman of the AIEE Admission and Advancement Department, continued the discussion of membership problems. He suggested several areas in which Sections should concentrate their efforts, such as retention of student associates after graduation, and sponsorship of education programs, an activity which offers great possibilities in attracting new members.

Mr. Black's remarks led to a discussion on the part of the audience on the question of affiliate members which indicated that the Sections would like to have exact definitions on various aspects of the af-

filiate grade including: to whom it should apply, policy toward affiliates on Section and National level, educational and professional requirements for eligibility.

Engineering Unity

The afternoon session of the meeting began with a discussion of "Progress Toward Unity of the Engineering Profession," by past AIEE President W. J. Barrett.

Mr. Barrett stated the importance of the Section Representatives becoming familiar with the AIEE Functional Plan (explained in *Electrical Engineering*, February 1958, pp. 119-21) as well as with a report prepared by the Intersociety Relations Committee of AIEE called "Position on Organization of the Engineering Profession" (*Electrical Engineering*, February 1959, pp. 124-27).

He mentioned the impracticality of a few unity proposals advanced by other societies in his remarks which stressed the necessity of unification, the problems confronting it, and the value of the AIEE Functional Plan.

Because the ultimate acceptance of the Plan will be brought about only if the engineers say they want it, Mr. Barrett urged the Sections to stimulate discussion of the Plan at local levels.

E. B. Robertson, past president of the Institute, 1953-54, and chairman of the Intersociety Relations Committee, also stressed the importance of the individual in the success of the Plan by remarking that we will have unity whenever engineers want it, not when someone imposes it on them. In response to a question from the floor, he discussed the American Medical Association and the American Bar Association in relation to the proposed engineers unity organization.

AIEE Electronic Installation

G. E. Herrmann, office manager at AIEE Headquarters, discussed three items of interest to the Sections: Renewal of Subscriptions to Bimonthly Publications and Transactions, Availability and Cost of Emplacquement of Diplomas and Certificates (see *Electrical Engineering*, January 1959, p. 99), and Electronic Installation at Headquarters.

Under the latter heading, he described in detail the electronic equipment, master card composition, and functions of the equipment, among which are: addressing *Electrical Engineering*, Bimonthlies, meeting notices; a Section memberbership counts by grades; dues payments listing, etc.

Student Branches

G. J. Grimm, chairman of the AIEE Student Branches Committee, remarked briefly on the success of the plan employed during the past year whereby Student Branches notify Sections into which graduating students are going to move in an attempt to retain students as members of AIEE.

Section and Subsection Changes

Mr. Sheppard announced three name changes regarding Sections: Mobile–Pensacola Section changed its name to Gulf Coast Section, Tampa Section changed its name to Florida West Coast Section, and Northwest Iowa Subsection changed its name to Siouxland Subsection. He also announced the formation of several new Subsections as follows: Alaska Subsection (Seattle Section), Central Florida Subsection (Florida West Coast Section), Panama City Subsection (Gulf Coast Section), Walla Walla Subsection (Richland Section), Orange County Subsection (Los Angeles Section), and Evansville Subsection (Central Indiana Section).

75th Anniversary of AIEE

Dixon Lewis, chairman, Ad Hoc Committee for Celebration of the 75th Anniversary of the AIEE, outlined the key items on the program for the 75th Anniversary, the slogan of which is "75 Years—A Prologue to the Future."

Some objectives of the program, which will concentrate on future possibiilties rather than past achievements, are to attract new members and hold the interest of old members, and to improve the standing of AIEE in the community.

Publicity aids for the program, prepared with the assistance of Raymond C. Mayer & Associates, public relations consultants to the Institute, include a new "75th Anniversary" publicity kit; a brochure in preparation, designed to help in Section activities, containing facts about the electrical engineering industry to key in with the 75th Anniversary; and an addition to the AIEE portable exhibit which will be used at meetings and conferences throughout the country.

Two special Anniversary meetings that have been planned were announced by Mr. Lewis. AIEE's original organization meeting was held on May 13, 1884. On or about that day this year, there will be a commemorative meeting to be organized by the New York Section. The first AIEE meeting at which technical papers were presented was held October 7-8, 1884, in Philadelphia. Next October a commemorative meeting will take place in that city with details worked out by the Philadelphia Section. Also announced was a special luncheon planned for the Summer and Pacific General Meeting in Seattle, Wash.

Mr. Lewis mentioned as an important part of the celebration the May issue of *Electrical Engineering* which will contain articles by leaders in the fields of engineering, science, education, and industry.

Since the success of the program will be measured by active participation on the Section level, it was suggested that during the year each Section hold at least one meeting devoted to a celebration of the 75th Anniversary.

Following Mr. Lewis, R. C. Mayer, Jr., described the contents of the 75th Anniversary publicity kit which was prepared with the co-operation of the Institute's Public Relations Committee under the chairmanship of J. A. Parrott. This kit will be sent to each Section chairman.

Section Finances

In his discussion of Section finances, Chairman Sheppard announced that the Sections Committee has recommended that certain monetary aid to Sections from AIEE Headquarters—bonuses for extra meetings, rebate of entrance fees and rebate of transfer fees—be continued on a permanent basis.

Forum of Technical Committee Chairmen Discusses AIEE Operational Procedures

WITH A VIEW toward providing background and information and assisting technical committee chairmen in their operational functions, the Forum of Technical Committee Chairmen held during the Winter General Meeting was devoted to a panel of four arranged talks. Led by AIEE President L. F. Hickernell, the first talk outlined improvements in technical operations; the second dealt with how to use Technical Operations Department (TOD) headquarters' services; the third with the importance of meeting deadline dates; and the fourth with how to improve the effectiveness of oral presentations and the conduct of technical sessions.

Improvements in Technical Operations

From intimate, personal experience, President Hickernell outlined the expansion of the Institute's technical organization from early days to the present, and summarized the suggestions from the 18 previous Forums. The expansion of the technical organization was likened to Parkinson's Law (a book), published by Houghton Mifflin Company, Boston, Mass., 1957, which outlines in stages the expansion of an ideal committee or cabinet consisting of five members; however, when the membership is expanded to 20 or more, the original five members or their counterparts start to meet in advance. With decisions already reached, little remains for the assembly to do and further expansion does not matter since the cabinet has already ceased to be a cabinet and has been succeeded in its original functions by some other body.

In similar fashion, the old Technical Program Committee consisted of both the Section and Technical Committee chairmen. As the number of Sections grew and the committee became unwieldly, the Section chairmen were removed and the Section Delegates Conference was established. Again, as the number of technical committees increased so that the Technical Program Committee became unwieldly, a Technical Advisory Committee consisting principally of the Division chairmen was organized in 1950 and the Forum of Technical Committee Chairmen was instituted.

In 1952, the Technical Advisory and Technical Program Committees were merged into the Technical Operations Committee, which in 1956 became the Technical Operations Department. A year later, this department became so large that an Administrative Committee of 17 members was instituted; thus completing the full cycle of Parkinson's Law.

As proof of the value of the Forums, in addition to indoctrination of new personnel and education in organization and procedures, President Hickernell referred to suggestions arising in the Forums which have been adopted, such as the preprinting of conference papers, the waiver of registration fee for invited nonmember authors, and the publication of mathematical papers without presentation. Other suggestions were classified as good but too expensive, and too complicated from an operating standpoint. Others are currently under study and some are not concerned directly with technical operations but should be referred to other departments. In conclusion, he suggested the possibility of holding a session to review and evaluate these suggestions in the interest of improving Institute operations.

How To Use TOD Headquarters' Services

As a former Secretary of the Basic Sciences Committee, Secretary of the Institute N. S. Hibshman outlined the ways to use TOD headquarters' services in several broad areas of activities. The term, "headquarters," was given a broader concept than just the paid staff; it includes the important volunteer services from officers of the departments who guide and co-ordinate the work of the technical committees while the employees carry out the mechanics of production and distribution.

In respect to the appointment of committees, the Secretary referred to the task of the presidential nominee to appoint or reappoint some 3,000 general and technical committee members. First, about 75 committee chairmen must be named, then the suggestions for committee men are sought from all of the Sections. These are sorted, collated, and distributed to the committee chairmen who review the names proposed and submit their recommendations to the presidential nominee. The quality of the technical operations depends on the personnel of these committees and their selection is critically important. The headquarters' service in this connection is one of co-ordination of communication back and forth between the President, the Committee chairmen, and the Section officers. The most effective use of this service can be made only by prompt and thoughtful response from all parties concerned.

In respect to the handling of papers on meeting programs, the Secretary described the steps taken in review, revision, scheduling on meetings programs, and announcements, on through to the appearance of the material in the publications, and the functions of the committee and headquarters in carrying out these activities. Effective use of the service calls for the absolute observance of deadines procedure set forth in the "Author's Guide" and the Organization Manual. If the process is delayed or goes wrong at any point, the results are likely to be most unhappy.

In the relationship between the Sections and TOD, reference was made to a useful pamphlet available at headquarters and the organization and guidance of Section technical groups. Some Sections have discovered the Special Technical Conferences a stimulating experience for their community and have worked very successfully with technical committees to handle these affairs. In the bringing together of Sections and technical committees and in the practical functions of financing, management, mailing, and the like, headquarters can be helpful.

In connection with prizes and awards for papers, the Secretary pointed out that the major part of the program is a technical committee function. The part likely to be played by the technical committees in the future program of recognition and awards in general is likely to be amplified by the inauguration of medals and awards for outstanding achievements in specific technical fields in the near future. This will call for interdepartmental co-ordination and additional staff service. In conclusion and closely related to the evaluation of individual contributions, the Secretary pointed out that it was the duty of the technical committees continuously to evaluate critically, summarize, and report on the state of the art and its associated literature. Surveys of areas of knowledge and lack thereof, and the identification of places where research, development, and standardization are needed all represent opportunities for technical committees to do important and valuable work. Such work would be quickly noticed in the academic world where more effective technical service from AIEE would be most helpful to all concerned.

Deadlines Are a Part of Your Job

By means of slides, A. C. Muir presented a calendar of 15 deadline dates to be met during the forthcoming year and in addition two roving deadlines—one for the completion of review of papers; the other for session program material to be sent to the Assistant Secretary. In respect to three meetings—Fall General Meeting in 1957 and the Winter and Summer General Meetings in 1958, Mr. Muir illustrated that approximately 32 to 54% of the reviews for these three meetings were late and 39 to 64% of the program information was late. In fairness to authors and the headquarters staff, he urged that everything possible should be done to correct the situation and offered the following suggestions to technical committee chairmen: (1) designate a member of the committee, possibly the vice-chairman, to receive the manuscripts and copies; (2) designate at least three reviewers for each paper; (3) advise Mr. Day of the member designated to receive the manuscripts; (4) tell the member who is to receive the manuscripts to advise his secretary about copies being sent for review in case of his absence from the office; and (5) alert all reviewers to the necessity of prompt review and return of the manuscripts.

Tuning In with Your Technical Audience

From long experience of attending many technical sessions, L. N. Rowley, publisher and editor of *Power*, gave valuable suggestions to improve the effectiveness of oral technical presentations as well as the conduct of the meetings by presiding officers. Among the many suggestions, some of which were illustrated negatively, were such important points as not to read from the paper but to talk informally from an outline on cards, speak into the microphone, pause between sentences, and keep out of the projection beam. As to guidance for presiding officers, emphasis was placed on the apportionment of time, avoidance of detailed biographical sketches, awareness and attention to failures of equipment. Before the start of a meeting, presiding officers should make a count down of all equipment, projection lanterns, blackboard, chalk, eraser, and pointer, and position of speaker's rostrum so that it does not interfere with projection. A meeting should take place in advance of the start of a session with all participants present: slides should be prompty tagged and others which are to be repeated should be marked. In addition, presiding officers should know where to turn the lights on and off, should be sure that an extra projection lamp is available, and take note of the ventilation. In regard to writing, Mr. Rowley suggested two valuable references, "The Art of Readable Writing" by Rudolph Flesch and "The Technique of Clear Writing" by Robert Gunning. For clear simple writing, the speaker suggested the use of short words, short sentences, direct statements, the use of active verbs, and the omission of Latin-root words wherever Anglo-Saxon ones tell the same story.

The forum was conducted by Hendley Blackmon, chairman of TOD, who introduced the speakers, answered questions from the floor, and called on other committee personnel to answer specific questions.

Eta Kappa Nu Honors Outstanding Young Electrical Engineers

THE ANNUAL Eta Kappa Nu Recognition Award Dinner was held in the Hotel Governor Clinton, New York, N. Y., February 2, 1959. The bowl commemorating the award to the outstanding young electrical engineer for 1958 was presented to Dr. M. R. Currie by President Larry Dwon of Eta Kappa Nu. The citation of honorable mention was presented to Dr. D. A. Buck.

Recognition of outstanding young electrical engineers has been determined each year since 1936 by Juries of Award to a young electrical engineer under 35 years of age, who has received his baccalaureate degree from an accredited electrical engineering curricula in the United States within the past 10 years. Consideration is on the basis of 50% for professional accomplishment, 20% for civic and national contributions, 10% for cultural achievements, and 20% for professional activities. Candidates are not necessarily Eta Kappa Nu members, and nomination blanks may be obtained from the Executive Secretary, Eta Kappa Nu Association, P. O. Drawer 447, Dillsburg, Pa.

LARRY DWON *(left)*, national president of Eta Kappa Nu, and Dr. Malcolm Currie *(right)*, winner of 1958 Recognition Award, examine the large bronze bowl on which are engraved the names of the 22 previous winners, and which is on display at AIEE Headquarters.

The Outstanding Young Electrical Engineer

The accomplishments of Dr. Malcolm Currie were related by Dr. A. V. Haeff, vice-president, Hughes Aircraft Company, Research Laboratory, where Dr. Currie is now head of the electron dynamics department. Under his leadership, very effective research work was done on low noise tubes, parametric amplifiers, plasma physics, fusion processes, and other important subjects. In early years, Dr. Currie was an accomplished violinist, and he was also interested in aviation and athletics. His bachelor of science and doctoral degrees were obtained from the University of California in Berkeley, where outstanding creative abilities were demonstrated by invention of several novel devices, which included the so-called backward wave amplifier having unique properties of electronic tunability over a wide frequency range while maintaining high gain and stability and high selectivity over the desired frequency bands. In addition, Dr. Currie has been an effective contributor to the promotion of improved educational methods in high schools through science-industry co-operative programs, and he personally delivered many lectures to high school students to stimulate interest in science.

In his response, Dr. Currie paid tribute to the influences of his mother and Prof. John Whinnery, for shaping his technical life and to Dr. Lester Field and Dr. A. V. Haeff, for the inspiration of their friendship and leadership which helped create a wonderfully enthusiastic atmosphere. For the benefit of younger engineers about to enter the profession, Dr. Currie spoke of the unlimited challenges which electronics research has to offer and the thrill and excitement of struggling with the many varied and complex problems. In conclusion, Dr. Currie stated that he was very proud to receive the award and he expressed heartfelt thanks to Eta Kappa Nu and the Awards Committee.

The Award of Honorable Mention

Honorable mention was awarded to Dr. D. A. Buck with the citation, "By virtue of his notable contributions in information handling techniques and his unstinting devotion to church and community." Dr. Buck obtained his baccalaureate degree from the University of Washington in Seattle and his M.S. and doctor of science degrees from Massachusetts Institute of Technology, where he was first a research assistant, then associate professor in 1958. He served as consultant with A. D. Little, Inc., as well as consultant with the National Security Agency.

The career of Dr. Buck was outlined by Prof. G. S. Brown, who pointed out that he was a man of many accomplishments who has led in the general applications of science. In regard to the enthusiasm of his lectures on cryogenics and energy and seriousness of purpose for its application, his colleagues have recognized as a scientific breakthrough the device which depends on low temperature phenomena known as the cryotron, a minute ON or OFF switching device that may find applications in computers. In regard to Dr. Buck's civic activities, Prof. Brown mentioned his visits to 14 high schools to interest students in science, his teaching of Sunday school, and his efforts toward increasing the school budget in Wilmington.

In accepting the award, Dr. Buck paid tribute to others and explained that work often comes through a man and not from him. He expressed his gratitude to the many people with whom he had come in contact over the years, and pointed out that many years often are required to evaluate the quality of work. Tribute was also paid to those who have done valuable work which has remained unrecognized. In conclusion, he cited that the award was a good way of judging high quality work.

Feature Address

At the conclusion of the ceremonies, a feature address, "New Perspectives of Professional Responsibility," was delivered by C. H. Linder, vice-president, General Electric Company and chairman of the Jury of Award. The speaker drew attention to the new perspectives required of scientists, engineers, and managers in the light of impact of many developments today and their professional responsibilities to achieve desired results. The full address appears on pp.339-41 of this issue.

Alan Hazeltine (F '35) was recently honored by the Smithsonian Institution when his original "Neutrodyne" radio receiver was made part of its permanent exhibit of important historical engineering and scientific achivements. In addition, a magnetic recording of an interview with Prof. Hazeltine, during which he described his interests and professional work which led to the invention, is also preserved at the Washington, D. C., shrine. The "Neutrodyne" type of receiver embodied a circuit for neutralizing the grid-plate capacitance of the triode r-f amplifying tubes. It was manufactured by many companies beginning in 1923, and in 1924 the Hazeltine Corporation was formed to license the invention. The superior performance of the Neutrodyne was a factor in the rapid growth of radio broadcasting in the 1920's. Prof. Hazeltine, who holds a mechanical engineering and an honorary D. Sc. degree from Stevens Institute of Technology and a master's degree in mathematics from Columbia University, was for several years chairman of the electrical engineering department at Stevens, and later transferred to the mathematics and physics departments. He is presently a director and consulting engineer to the Hazeltine company.

ALAN HAZELTINE and his original 1922 model of the Neutrodyne receiver.

Luigi Emanueli

Honorary Member of the Institute

THE BOARD OF DIRECTORS of the AIEE, at a meeting held in Buffalo, N. Y., on June 27, 1958, unanimously elected Luigi Emanueli* (F '56), general manager of Pirelli Societa per Azioni, Milan, Italy, an Honorary Member of the Institute. For the presentation of the award, a local committee was set up at the request of the President of AIEE consisting of he following Italian members of the AIEE: Prof. Agostino Dalla Verde, chairman; Giuseppe Palandri, secretary; Prof. Arnaldo Maria Angelini; Franco Bianchi di Castelbianco; Franco Castelli; Prof. Mario Mainardis; Edilio Pautrie; Prof. Emilio Santuari; Prof. Marco Semenza; and Francesco Tedeschi.

The diploma was presented at a ceremony which took place in Milan at 11 a.m. on November 7, 1958, in the "Sala del Cenacolo" of the Museum of Science and Technology, before an assembly of distinguished people representing the scientific and industrial world.

The importance of the event was stressed by Prof. Agostino Dalla Verde, president of the Italian Association of Electrical Engineers, and by Dr. Alberto Pirelli, the oldest Italian Member of the AIEE, who presented the award on behalf of the Institute to Luigi Emanueli.

* It is regretfully announced that Dr. Emanueli died February 17, 1959, in Milan, Italy, of a heart attack. He was 75 years old.

HONORARY MEMBER DIPLOMA presented to Dr. Luigi Emanueli on November 7, 1958, in the Museum of Science and Technology, Milan, Italy: (*left to right*) Prof. Agostino Dalla Verde, president of the Associazione Elettrotecnica Italiana; Dr. Alberto Pirelli, oldest Italian Member of AIEE and chairman of the Pirelli Company; and Dr. Emanueli.

Remarks by Dr. Pirelli

Following are some excerpts from Dr. Pirelli's presentation address.

"I consider it a great privilege to have been delegated by the President of the American Institute of Electrical Engineers to present the diploma of Honorary Member of that Institute to Luigi Emanueli, a distinction which has been conferred on only 45 persons during the 75 years of existence of the Institute, among them Pacinotti and Marconi. With his election Dr. Emanueli becomes the eighth Honorary Member living today.

"It is with great pride that I represent here today an Association counting more than 50,000 members, mostly engineers related to the sciences and electrotechnical industries in the United States of America. We are fully conscious of the fact that, as great as may be the contribution which Europe has given, and is still giving, the whole world has benefited enormously from the theoretical investigations and creative impetus originating in the United States in this field of knowledge and activity.

"I am afraid I cannot consider myself qualified scientifically to carry out this happy duty—even though I am the oldest Italian member of the AIEE—but I venture to say that no one could perform it with more sincere pleasure, nor with greater conviction, a close spectator as I have been for more than half a century of the activities of Emanueli in the field of research and of achievement."

Dr. Pirelli spoke of the international significance of the award in particular, and of technological progress in general:

"A form of tribute which, crossing the frontier of a country welcomes colleagues from other countries to its family of scientists and technicians, is full of the highest significance. Art, too, knows no frontiers, and a particular work of art, or a school of art, frequently migrate beyond the frontier of their country of origin, but in the world of science the course of events is of an entirely different nature; there is a sense of cordial international collaboration, wherein the various activities integrate with one another to converge toward a common goal, and each, in his progress, helps others in the ascent. In fact, the higher the level of scientific culture, the keener is this brotherhood between men of perhaps different origin, or engaged in different fields, just as the paths which lead to the mountain top draw nearer and nearer as they rise. It is, in fact, true that when Russian scientists, after having been cut off from the rest of the world for many years, were again allowed to contact with their colleagues in the West, these latter were greatly impressed by the in-

THE SALA DEL CENACOLO of the Museum of Science and Technology in Milan, Italy, was the scene of the presentation of the Honorary Member diploma to Luigi Emanueli.

terest they showed, by their eagerness to exchange ideas, and their satisfaction in finding a common language for their discussions.

"One can even wonder whether the continued development of technology in civilization may not be the means of fostering a greater affinity of the mind than has been possible in the past through politics, religion, and even the arts, and we must hope that its attractions and sovereignty will always go hand in hand with an affirmation of the spiritual values of life, and, above all, that the forces of evil which it can generate will not be let loose, whilst it can give birth to so much good."

He concluded with the following remarks.

"The historian who will write of our age may appear a bitter satire when dealing with many aspects of home and international politics of the different countries of our world. The art critic will, only with some effort and indulgence, succeed in preparing the epitaph of various forms of art of our times, but the scientist—whether referring to pure or applied science—will certainly consider our century as an era of brilliant progress. The sociologist will in turn tell to what extent this scientific and technological progress, which has among other things brought about a reduction in costs, has been an essential factor in social advance. Fortunate are the men who can work with a clear understanding of this dual gift. To one of the most eminent of these I now hand, with high esteem and brotherly affection, the diploma of Honorary Member of the American Institute of Electrical Engineers, fully conscious of the importance of the Association I am called upon to represent, and of how worthy the receiver is of such outstanding recognition."

Achievements

Dr. Emanueli was born on April 5, 1883, in Milan, and graduated from the Milan Polytechnic School with a degree of E.E. in 1906. Since 1907, he had been associated with the Pirelli Company of Milan, first as research engineer, since 1918 as chief engineer, since 1930 as director, and since 1943 as general manager. His studies prior to 1917 led to the invention and commercial development of the Pirelli oil-filled cable, the first practical method of transmitting electric energy via underground cable at voltages above 69 kv. With the installation of this type of cable for 132-kv service in 1927 in the United States, the effectiveness and efficiency of all underground transmission systems in large cities has increased considerably. He continued his research of the behavior of cables under different working conditions since that time. He was instrumental in the design of various laboratory apparatus for testing cables and various components of cables. He prepared numerous publications on cables which have been translated into many languages, and he received prizes for papers presented to AIEE and other technical organizations.

Dr. Emanueli was past Honorary Secretary of the Institute of Electrical Engineers, London, England; Honorary Member of the Societe Francaise des Electriciens, Paris, France; past president of the Associazione Elettrotecnica Italiana, Milan; and a "Grande Officiale" of the Italian Republic.

Awards Presented in Safety Contest

The American & Foreign Power Company recently awarded the first six bronze plaques in its new accident prevention contest. This was the first safety contest of the American & Foreign Power System where the individual operating companies competed against one another. In the previous contests, the competition was arranged on a country-by-country basis, based on the over-all performance of all Foreign Power System companies in each country. It was felt that this new arrangement gave each single company the best opportunity to demonstrate its capabilities in accident prevention work.

The associated companies which operate in 11 Latin American countries were divided into four groups. The first group of electrical operating companies had over 750 employees each; group 2 had 350 to 749 employees; group 3 less than 350 employees; and group 4 included all the other types of operations, such as telephone, gas, tramways, and launches.

This first contest started in April and ended in September 1958. This particular time was selected so that all the statistics could be tabulated and the plaques engraved in order to have the presentation ceremonies at the Annual Executives' Conference of American & Foreign Power Company and Ebasco International Corporation which is held in New York, N.Y., each December.

Two awards were presented in each of the three groups. The first award was the "Safety Award" and was won by the company with the lowest Injury Index for the contest period (Injury Index = Frequency Rate + 10 × Severity Rate). The second award, "The Improvement Award" was won by the company achieving the greatest reduction in the Injury Index. A comparison was made with the Injury Index of September 1957 for this purpose. Special mention was given to those companies in group 4 for notable records.

The winning companies and their records are as follows:

Group 1

Safety Award—Pernambuco Tramways & Power Co. Ltd. (Brazil), Injury Index 3.27

Improvement Award—Cia Paulista de Forca E Luz (Brazil), Injury Index Improvement Points 42.20

Group 2

Safety Award—Empresa Electrica del Ecuador, Inc. (Ecuador), Injury Index 1.58

Improvement Award—Cia Cubana de Electricidad Santa Clara Division (Cuba), Injury Index Improvement Points 56.47

Group 3

Safety Award—Cia Electrica de Merida (Mexico), Injury Index 0

Improvement Award—Cia Forca e Luz Nordeste do Brasil (Brazil), Injury Index Improvement Points 101.92

This first contest was very successful. Considerable enthusiasm was shown by all companies and many accident prevention campaigns were planned around the contest. The American & Foreign Power Company intends to make this a permanent annual event, but with the contest running for a full year.

As a result of this and similar accident prevention contests and campaigns, the acceptance of individual responsibility for correct safety practices has steadily increased in all Latin American countries. Each individual employee is now realizing that accident prevention is his responsibility and not solely that of the "safety department." This feeling, coupled with the enthusiastic support and direction of top management, is earning considerable benefits for all in Latin America.

L. E. HAUGHEY, assistant to the president of Cia Impulsora de Empresas Electricas (Mexico) receives the Safety Award for Cia Electrica de Merida from H. B. Sargent (M '40), president, American & Foreign Power Company.

Standard Flashlight Co., Inc.

Papers Presented at the 1959 AIEE Winter General Meeting

A LISTING of the papers presented at the 1959 Winter General Meeting of the Institute, February 1-6, New York, N. Y., follows. Copies of numbered papers only are available to members for 40¢ each and to nonmembers for 80¢ each. Send order and remittance to: AIEE Order Department, 33 W. 39th St., New York 18, N. Y. Papers marked CP* have not been printed by the Institute.

Industrial Mercury-Arc and Semiconductor Power Rectifiers

CP59-367. Tests on a Main Mill Drive Ignitron Rectifier Power Supply. *W. R. Hodgson*, Westinghouse Electric Co.

CP59-237. Silicon Rectifier Application to Low-Voltage Electrolytic Processing. *R. C. Scott*, Canadian Westinghouse Co., Ltd.

CP59-294. Medium-Power Silicon Rectifiers for General Industrial Power Supply. *D. W. Borst, L. W. Burton*, General Electric Co.

Transmission and Distribution

59-34. An Economic Study of D-C vs A-C Overhead Transmission. *A. J. Wood, S. B. Crary, C. Concordia*, General Electric Co.

59-108. Progress in Extrahigh-Voltage Power Transmission. *P. A. Abetti, S. B. Crary*, General Electric Co.

59-66. Work Done in the Soviet Union on High-Voltage Long Distance D-C Power Transmission. *A. M. Nekrasov*, Ministry of Power Stations of U.S.S.R.; *A. V. Posse*, Scientific Research Institute of Direct Current, USSR (Re-presented for Discussion only)

59-4 Insulation Requirements of High-Voltage Transmission Lines for 115 Kv to 460/500 Kv. *P. L. Bellaschi*, Portland, Oreg.

CP58-1256. Application of Electronic Computers to Structural Design of Transmission Towers. *A. M. Lount*, A. M. Lount and Associates.

Transformers

59-243. Automatic Ratio Control Transformer and Regulator. *J. S. Malsbary*, Wagner Electric Corp.

59-65. Static Relay Control for 3-Phase Step Regulators. *C. J. Kettler, R. L. Elliott*, General Electric Co.

59-56. The Calculation and Measurement of Axial Electromagnetic Forces on Concentric Coils in Transformers. *M. F. Beavers, C. M. Adams*, General Electric Co.

59-72. Phasor Power Method of Determining Transformer Sequence Impedances. *B. A. Cogbill*, General Electric Co.

Rotating Machinery

58-1218. Proposed Test Procedure for Noise Measurements on Rotating Electric Machinery. A Committee Report, *C. G. Veinott*, Chairman.

58-1179. How To Specify the Noise Rating of Large Electric Rotating Machines. *M. E. Talaat*, Elliot Company.

CP-58-1290. Effect of Air Gap Eccentricity on Motor Sound Level. *J. J. Courtin*, Westinghouse Electric Corp.

58-849. Sources of Electromagnetic Vibration in Single-Phase Induction Motors. *L. W. Magyar*. (Re-presented for Discussion only)

58-1320. Torque and Speed Control of Induction Motors Using Saturable Reactors. *J. F. Szablya*, University of British Columbia.

Computers in Control Systems

CP58-1182. Progress in Sampled-Data Systems. *E. I. Jury*, University of California.

CP.* Survey of Sampled-Data Systems Analysis. *J. V. Howell*, Packard Bell Computer Corp.

59-52 The Stability and Compensation of Saturating Sampled-Data Systems. *F. J. Mullin*, California Institute of Technology.

58-1291. A General Approach for Obtaining Transient Response by the Use of a Digital Computer. *P. E. Lego*, Westinghouse Electric Corp.; *T. W. Sze*, University of Pittsburgh.

Comparison of Electron Tubes with Semiconductor Devices

CP.* Survey of the Relative Status of Solid-State Devices and Tubes with Respect to Applications in Army Equipments. *K. Garoff, D. P. Salvano*, U.S. Army Signal Research and Development Lab.

CP59-442. Shall an Electron Tube or a Semiconductor Device Be Used? *E. E. Scheneman, S. K. Waldorf*, Westinghouse Electric Corp.

CP59-411. Tubes vs Transistors—A Realistic Assessment. *R. E. Moe*, General Electric Co.

CP59-370. Transistors and Tubes in Telecommunications. *B. T. Howard*, Bell Telephone Labs.

Russian Education and Technology

CP.* My Experience in the Soviet Educational System. *V. Rudolph*, New York City (J. A. Strelzoff, Interpreter)

CP.* A Survey of Russian Education. *W. W. Brickman*, New York University.

CP.* Engineering Education in the USSR. *L. Trilling*, Massachusetts Institute of Technology.

CP59-368. Russian Technology—Computers and Information. *R. K. Honaman*, Bell Laboratories.

CP.* Russian Technology—Solid-State and Transistors. *W. C. Dunlap*, Raytheon Mfg. Corp.

CP.* Russian Technology—High-Voltage A-C and D-C Power Transmission. *P. A. Abetti*, General Electric Co. Panel discussion led by E. A. Walker, Pennsylvania State University.

Electric Heating

59-31 Control of Infrared Radiation. *I. J. Barber*, The Fostoria Pressed Steel Corp.

59-77. Some Unusual Designs of Electrical Resistance Heating. *L. P. Hynes*, Haddonfield, N. J.

59-30. Rapid Heating of Dielectric Materials at 915 Mc. *G. E. Feiker, N. C. Gittinger*, General Electric Co.

59-64. Electric and Magnetic Conditions Inside an Induction Heated Workpiece. *C. A. Tudbury*, New Rochelle Tool Corp.

CP59-256. Three-Phase Induction Heating Coils. *N. V. Ross*, Magnethermic Corp.

Management

CP59-274. Planning for Methods Improvement. *G. A. Antonette*, Detroit Edison Co.

CP.* Work Measurement for the Engineer and for Management. *J. F. McQuillin*, West Penn Power Co.

CP58-1145. Managing Research Laboratory Finances. *T. M. Linville, C. S. Van Wormer*, General Electric Co.

CP.* Criteria for the Selection of Engineers for Employment. *L. H. Noggle*, Westinghouse Electric Corp.

Cathodic Protection

CP59-372. The Effect of Electrical Grounding Systems on Underground Corrosion and Cathodic Protection. *B. Husock*, Harco Corp.

CP59-388. Trends in Ground Bed Design for Cathodic Protection of Underground Structures. *A. P. Landry, I. N. Howell, Jr.*, Southern Bell Telephone and Telegraph Co.

CP.* Cathodic Protection Applications at the Hanford Works. *C. S. Bucholz*, General Electric Co.

Modern Circuit Techniques—I

CP59-260. Transistor External Parameters. *A. V. J. Martin*, Carnegie Institute of Technology; *H. Schreiber*, Paris University.

CP.* Considerations for the Design of High-Gain, Low-Drift, Transistor Direct-Coupled Amplifiers. *J. Kline*, University of Rhode Island.

CP.* A Low-Level Application of the Drift-Transistor. *J. A. Forbes*, Minneapolis-Honeywell Regulator Co.

CP.* A Transistor Trigger Circuit Exhibiting an Accurately Defined Triggering Threshold. *F. S. Goulding, L. B. Robinson*, Atomic Energy of Canada, Ltd.

CP59-257. A Proportional Transistor Switching Circuit. *A. N. DeSautels*, Minneapolis-Honeywell Regulator Co.

Educational Television

59-194. A Design for Using Closed-Circuit Television in Education. *F. E. Almstead*, New York State Education Dept.

52-229. A Talk-Back System for Educational Television. *R. C. Norton, J. B. Davidson*, New York Telephone Co.

CP59-200. A Transmission Design for Closed-Circuit Educational Television. *W. L. Wall*, New York Telephone Co.

CP.* Progress in Educational Television. *C. M. Braum*, Joint Council on Educational Television.

Data Communications

58-1181. Optimum Block Length for Data Transmission with Error Checking. *F. B. Wood*, International Business Machines Corp.

58-300. Synchronized Clocks for Data Transmission. *J. O. Edson, M. A. Flavin, A. D. Perry*, Bell Telephone Laboratories (Re-presented for Discussion only)

CP59-454. Sync Recovery for Data Transmission. *F. H. Shepard, Jr.*

Radio Communication Systems

CP.* ABC's of PCM. *J. Cohn*, Motorola.

CP58-1375. UHF Exciter for Single Sideband. *S. Kitces*, Westinghouse Electric Corp.

CP.* Automatic VHF Telecommunications for Oil Operations in Central Sumatra. *V. J. Nexon*, MSI Communications Consulting Engineers.

59-61 Synchronous Methods of Operation for Private Telegraph Networks *B. S. Diamond*, Madison, N. J.

58-989. Systems Engineering of Personal Radio Signaling System. *W. Strack*, Bell Telephone Labs. (Re-presented for Discussion only)

Nuclear Power Plants—I

58-1199. Electrical and Control Features of the Shippingport Atomic Power Station. *H. G. Frus, H. A. Thompson, H. A. Van Wassen, E. J. Woolever* Duquesne Light Co.

CP58-1376. Operating Experience on Vallecitos Boiling Water Reactor. *L. Kornblith*, General Electric Co.; *W. Raymond*, Pacific Gas and Electric Co.

58-1273. Performance of the Sodium Reactor

Experiment. *J. E. Owens, W. T. Morgan, L. E. Glasgow*, Atomics International.

CP59-377. Design Problems and Operating Experience on the APPR-1. *K. Kasschau*, ALCO Products, Inc.

Electronics Transformers—I

CP59-146. Active Network Equivalent Circuits for the Transformer. *J. R. Allder*, University of California.

CP59-9. Small Current-Limiting Power Transformers. *H. L. Garbarino*, Magnaflux Corp.; *L. J. Stratton*, Jack and Heintz, Inc.

59-148. Design of a Vertical Magnetic Recording Head with Large-Scale Models. *J. T. Smith*, IBM Corp.

Rotating Machinery

CP59-312. Basic Considerations for Ratings and Performance of Eddy Current Couplings. *W. J. Cherones*, Harnischfeger Corp.; *E. H. Frederick*, Dynamatic Div. of Eaton Mfg. Co.

CP59-123. Performance of Electrically Operated Magnetic Particle Couplings. *J. S. Barrett*, Vickers Inc.

CP59-427. Performance of Disc Type Friction Clutches in Oil. *W. C. Pierce*, Warner Electric Brake & Clutch Co.

58-1158. Polyphase Induction Motors with Unbalanced Rotor Connections. *B. N. Garudachar, N. L. Schmitz*, University of Wisconsin.

Symposium on Conductor Vibration

59-105. A Mobile Vibration Laboratory Unit for Monitoring Dynamic Characteristics of Overhead Transmission Lines—Dynalab. *J. R. Ruhlman, J. C. Poffenberger, S. Grosshandler*, Preformed Line Products Co.

59-209. Progress Toward Optimum Damping of Transmission Conductors. *J. E. Sproule, A. T. Edwards*, Hydro Electric Power Commission of Ontario.

CP59-178. Improved Systems for Recording Conductor Vibration. *C. B. Rawlins, J. R. Harvey*, Aluminum Company of America.

59-208. Aeolian Vibration Tests on the 345-Kv Muskingum–Tidd Line. *E. S. Zobel*, American Electric Power Service Corp.; *A. N. Shealy, F. W. DeMoney*, Kaiser Aluminum & Chemical Corp.; *R. R. Ruegemer*, University of Wisconsin.

59-90. Automatic Electronic Control of Vibration Tests. *R. A. Schomburg*, The Martin Co.; *F. J. Trebby*, Kaiser Aluminum and Chemical Corp.

59-96. Transmission Conductor Vibration Tests. *M. B. Elton*, Bonneville Power Administration; *A. R. Hard*, Washington State College; *A. N. Shealey*, Kaiser Aluminum and Chemical Corp.

Transformers

59-35. Equivalent Circuits for Overcurrent Calculations of Current Transformers. *E. E. Conner, T. R. Specht*, Westinghouse Electric Corp.

CP-59-242. The Presentation of Transformer Theory. *T. H. Barton*, McGill University.

58-936. Natural Frequencies in Power Transformer Windings. *I. Johansen*, Massachusetts Institute of Technology.

58-1325. Computers Change Transformer Design Philosophy. *H. J. Weber, G. Gallousis*, Allis-Chalmers Mfg. Co.

Rotating Machinery

CP59-131. Synthesis of Induction Motor Designs on a Digital Computer. *C. G. Veinott*, Reliance Electric and Engineering Co.

59-57. Optimum Machine Design by Digital Computer. *G. L. Godwin*, Westinghouse Electric Corp.

CP59-133. Motor Speed-Torque Curves by Digital Computers. *J. M. Shulman*, Westinghouse Electric Corp.

Case Histories of Computers in Automatic Control

CP59-230. The Closed-Loop Concept of Real Time Flight Analysis. *G. Hintze*, White Sands Missile Range.

CP.* Heat-Rate Computer Involving Digital and Analog Multiplexing Controls. *G. Jacobi*, General Electric Co.

CP.* Application of Logic Techniques to a Steel Mill. *W. D. Rowe, F. G. Willard, F. Dinicolantonio*, Westinghouse Electric Corp.

CP.* Computer Control of a Butane Isomerization Process. *T. Stout*, Ramo Wooldridge Corp.

Electrical Insulation

CP59-322. High Temperature Radiation Resistance of Several Silicon Insulation Systems. *C. G. Currin, F. A. Smith*, Dow Corning Corp.

CP59-134. The Effects of Nuclear Radiation on the Dielectric Strength of Air. *G. I. Duncan, J. C. Fraser, B. Valachovic*, General Electric Co.

CP59-311. The Interconversion of Radiological Units. *C. H. Cheek*, Naval Research Lab.

59-117. Effects of Gamma Radiation at 25 C on Silicone Dielectrics. *C. G. Currin*, Dow Corning Corp. (Re-presented for Discussion only)

58-878. Effects of Neutron and Gamma-Ray Irradiation on the Dielectric Constant and Loss Tangent of Some Plastic Materials. *R. A. Weeks, D. Binder*. Oak Ridge National Lab. (Re-presented for Discussion only)

Electronics Transformers—II

CP59-119. Specifying a Pulse Transformer for Computer Use. *R. R. Blessing*, International Business Machines Corp.

CP59-120. Electronics Transformer Design by Digital Computers. *L. F. Deise, W. Etchison, R. Lee*, Westinghouse Electric Corp.

CP.* Design of Electronic Power Transformers by Digital Computers. *G. Walters*, General Electric Co.

59-48. Digital Computer Design of Pulse Transformers. *P. E. Lego, R. L. Greene, J. M. Banic*, Westinghouse Electric Corp.

Power Source for Satellites

CP.* New Developments in Solar Batteries. *M. Wolf*, Hoffman Semiconductor Div.

CP.* Fuel Cells. *D. Douglas*, General Electric Labs.

CP.* Considerations Concerning Power Sources for Satellites. *J Leisenring*, General Electric Co.

CP59-329. Parameter Measurements for Thermoelectric Generators. *C. S. Duncan, S. J. Angello*, Westinghouse Research Laboratories.

Industrial and Commercial Power Systems

(The price of S-108 is $1 per copy)

S-108. Electrical Safety—Everybody's Problem. *J. W. St. Andre*, Kaiser Aluminum & Chemical Corp.

S-108. Designing Industrial Electric Systems for Safety. *R. H. Kaufman*, General Electric Co.

S-108. Designing Industrial Power Distribution Equipment with Safety in Mind. *P. L. Camp*, I-T-E Circuit Breaker.

S-108. Lockout and Tag Procedure in an Industrial Plant Power System. *C. E. Wilson*, Bethlehem Steel Co.

S-108. Safety Precautions on a Plant Electrical System. *W. H. Brady*, E. I. du Pont de Nemours and Co. (Inc.)

Recognition in a Profession

CP.* Professional Registration. *N. L. Freeman*, N. Y. State Education Dept.

CP.* Engineering as a Profession. *Reverend J. T. Tinnelly, C.M.*, St. John's University.

Data Communications

58-1240. Assessment of Effects of Delay Distortion in Data Systems. *A. D. Fowler, R. A. Gibby*, Bell Telephone Labs.

58-1241. Measurement of Narrow Band Noise on Telephone Facilities in Connection with Analog Data. *J. O. Edson, F. E. Froelich, R. K. Townley*, Bell Telephone Labs.

59-107. Application of Telegraph Techniques in Data Transmission. *A. Boggs, J. E. Boughtwood*, Western Union Telegraph Co.

58-1204. An FM Digital Subset for Data Transmission. *L. A. Weber*, Bell Telephone Labs. (Re-presented for Discussion only)

Radio Communications

59-86. Tests Conducted Over High Reflective Terrain at 4,000, 6,000, and 11,000 Megacycles. *A. G. Oxehufwud*, American Tel. & Tel. Co.

58-1236. Radio Attenuation at 11 Kmc and Some Implications Affecting Relay System Engineering. *S. D. Hathaway, H. W. Evans*, Bell Telephone Labs.

59-6. The CCITT Multichannel Radio Relays and White Noise. *C. A. Parry*, Page Communications Engineers, Inc.

59-87. The Design of the Corner Reflector Antenna. *H. P. Neff, Jr., J. D. Tillman*, University of Tennessee.

CP59-88. The MLD-4 Microwave Relay System. *J. J. Lenehan*, The Western Union Telegraph Co.

Traveling-Wave Tube Development

CP.* Periodically Focused Traveling-Wave Tubes for Operation under Extreme Environmental Conditions. *E. E. Bliss.*

CP.* Design for Traveling-Wave Tubes for Airborne Applications. *M. Nowogrodzki.*

CP.* A New Backward Wave Oscillator for the 4 to 5 Millimeter Region. *J. A. Noland, L. D. Cohen*, Sylvania Electric Products, Inc.

CP.* The RCA-*7111*—A Very High-Performance Tunable Magnetron. *V. J. Stein.*

CP.* Long-Life Characteristics of Traveling-Wave Tubes and Magnetrons. *E. W. Kinaman, R. W. Kissinger.*

Nuclear Power Plants—II

58-1289. Electrical Features of the Yankee Atomic Electric Plant. *E. T. Witt*, Stone and Webster; *C. F. Obermesser*, Westinghouse Electric Corp.; *R. E. Minkwitz*, New England Power Service Co.

58-1194. Electrical Features of Indian Point Nuclear Electric Generating Station. *T. D. Reimers*, Consolidated Edison Co. of N. Y., Inc.

58-1219. A Look at the Electrical Features—Dresden Nuclear Power Station. *W. J. Shewski*, Commonwealth Edison Co.

58-1272. Organic Moderated Reactors for Central Station Power. *W. E. Parkins, E. F. Weisner*, Atomics International.

TASO Report and Stereo Hi-Fi

CP.* TASO Report. *Dr. G. R. Town*, Iowa State College.

CP.* The Development of a High Quality Stereophonic Pickup. *W. O. Stanton*, Pickering & Co. (Stereophonic Demonstration).

CP.* Ampex Demonstration. *J. Miller*, Ampex Corp.

CP.* The Design of a Mechanism To Handle Magnetic Tape in a Cartridge. *A. D. Burt, D. R. Andrews*, Radio Corp. of America (Stereophonic Demonstration).

Modern Circuit Techniques—II

CP.* Thyristor Monostable Rectangular and Sawtooth Pulse Generators. *R. W. Ahrons, C. A. Von Urff*, Radio Corp. of America.

CP.* High-Capacity Reversible Magnetic Counter for Real Time Systems. *E. A. Fisch, B. Silverman, E. P. Stabler*, General Electric Co.

CP.* Design and Analysis of the Bi-Logical Computer Element. *A. Lemack*, Sylvania Electric Products, Inc.

CP.* On the Design of Fractional Microsecond Magnetic Memories. *J. E. Thomas*, Sylvania Electronic Systems.

CP.* Time-Base Computation Techniques. *H. W. Abbott, V. P. Mathis*, General Electric Co.

Symposium on Wood vs Steel for EHV Transmission Lines

CP59-447. Composite Poles for Extrahigh-Voltage Wood Structures. *W. A. Schultz, J. E. McKinster*, Public Service Co. of Indiana, Inc.; *L. T. Williams*, Southwestern Electric Power Co.

CP.* Wood Structures for 345-Kv Transmission Construction. *R. G. Yerk*, Hughes Bros., Inc.

CP59-315. The Use of Wood for 345-Kv Transmission Construction. *L. H. J. Cook*, The British Columbia Electric Co., Ltd.

59-67. The British Columbia Electric Company's 360-Kv and 230-Kv Transmission Line Designs. *L. H. J. Cook*, The British Columbia Electric Co., Ltd.

CP59-429. The Place of Steel and Wood for High-Voltage Transmission Lines. *A. V. Price*, Ebasco Services, Inc.

59-106. Steel Towers for the Extrahigh-Voltage System of the Bonneville Power Administration. *F. W. Farr*, Bonneville Power Administration.

Transformers

CP59-281. Accelerated Aging Characteristics of Formex and Paper-Insulated Wire in Transformer Oil. *M. F. Beavers, H. H. Brustle, I. H. Carpenter, W. J. Degnan*, General Electric Co.

CP59-397. Report on Test Procedures for Thermal Evaluation of Oil-Immersed Transformers. AIEE Sub-Group on Thermal Evaluation of Oil-Immersed Transformers of the Insulation Life Committee of AIEE Transformer Committee. *A. M. Lockie*, Chairman.

59-43. Inner Cooled Shell Form Power Transformers. *W. D. Albright, H. R. Moore*, Westinghouse Electric Corp.

58-1150. The Relationship between Operating Voltage and the Standard Dielectric Tests for Power and Distribution Transformers. AIEE Committee Report, *H. H. Wagner*, Chairman.

Rotating Machinery

59-122. The Application of Digital Computers to Rotating Machine Design. *G. W. Herzog, O. W. Andersen, J. Scrimgeour, W. S. Chow*, Canadian General Electric Co., Ltd.

59-54. The Analysis of Sudden Short-Circuit Oscillograms of Steam Turbine Generators. *D. Harrington, J. I. Whittlesey*, General Electric Co.

59-40. Theory of End-Winding Leakage Reactance. *V. B. Honsinger*, Allis-Chalmers Mfg. Co.

59-39. Measurement of End-Winding Leakage Reactance. *V. B. Honsinger*, Allis-Chalmers Mfg. Co.

59-11. Constant Excitation Current-Locus Diagrams of Saturated Salient-Pole Synchronous Machines. *S. A. Nasar*, Ahsanullah Engineering College.

Adaptive Control Systems

CP.* Use of Mathematical Error Criteria in the Design of Adaptive Control Systems. *C. Merriam, III*, Massachusetts Institute of Technology.

CP.* Control by Stochastic Adjustment. *J. E. Bertram*, IBM Corp.

CP.* Is This an Adaptive System? *G. F. Franklin*, Stanford University.

CP.* Executive-Controlled Adaptive Systems *R. Staffin*, Polytechnic Institute of Brooklyn.

Electrical Insulation

58-1239. Electric Breakdown of Gases and Vapors of Chlorofluorohydrocarbons. *C. N. Works, E. W. Lindsay*, Westinghouse Electric Corp.

59-114. Experience with the AIEE Subcommittee Test for Gaseous Insulation. *M. L. Manning*, McGraw Edison Co. (Re-presented for Discussion only).

59-74. Factors Controlling Electric Strength of Gaseous Insulation. *P. Narbut, D. Berg, C. N. Works, T. W. Dakin*, Westinghouse Electric Corp.

CP59-258. The Solubility of SF_6, C_4F_8, and N_2 in Transformer Oil. *N. Vanderkooi*, Allied Chemical Corp.

CP58-1179. Applications and Research Progress in Gaseous Dielectrics. *T. W. Liao, H. G. Pfeiffer, R. E. Plump*, General Electric Co.

CP59-334. Arc Recovery Strength of Gases at High Current. *G. A. Farrall, J. D. Cobine*, General Electric Co.

New Electron Tube Developments

CP.* Development of Switch Tubes for Controlled Fusion Research. *D. B. Cummings*, University of California.

CP59-332. The Effects of Bulb Temperature and Filament Voltage Variations on Subminiature Tube Life. *M. W. Edwards*, General Electric Co.

CP59-374. The Development of a Front-End Tube for Reduced Crossmodulation and Noise. *A. A. Jalajas, K. W. Uhler*, Radio Corp. of America.

CP59-400. A Frame-Grid Audio Pentode for Stereo Output. *J. L. McKain, R. E. Schwab*, Sylvania Electronic Tubes.

Solid-State Devices

CP59-383. A Fast Thermoelectric Measuring Device. *P. Klein*, General Electric Co.

CP.* Parametric Devices — Solid-State Breaks the Microwave Barrier. *W. R. Beam*, Radio Corp. of America.

59-69. Remotely Controlled Electroluminescent Totaling Display. *R. C. Lyman, C. I. Jones, A. Leger*, Westinghouse Electric Corp.

CP.* Exact and Approximate Methods for Calculating Thermoelectric Efficiencies. *B. Sherman, R. R. Heikes, R. W. Ure*, Westinghouse Research Laboratories.

Industrial and Commercial Power Systems

CP59-7. Electrical Maintenance of a large Chemical Plant. *W. A. Reece*, The Dow Chemical Co.

CP59-244. Education and Maintenance in the Operation of Industrial Power Systems. *W. A. Weddendorf*, Mutual Boiler & Machinery Insurance Co.

CP59-19. Preventive Maintenance on Industrial Switchgear, Transformers and Cables. *D. B. Kiefer*, Bakelite Co.

CP.* Designing and Selling to Management a Power Distribution System with Maintenance in Mind. *R. Felch*, Owens-Corning Fiberglas Corp.

CP58-1344. Role of Modern Switchgear in Preventing and Coping with Operating Emergencies. *W. P. Burt, W. A. Fleischli*, General Electric Co.

Recording and Controlling Instrumentation

CP59-156. Interchangeable Errors in Instrument Systems. *G. M. Anderson*, Thomas A. Edison Industries.

CP59-160. A Transistor Oscillator Limit Switch for Indicating and Recording Instruments. *J. T. Wintermute, S. G. Hayter*, Westinghouse Electric Corp.

59-157. A Magnetic Amplifier Flow Controller. *H. E. Darling*, The Foxboro Company.

Batteries

CP.* Recharge Characteristics of Lead Acid Batteries. *R. C. Shair*, Bell Telephone Labs., Inc.

CP.* Storage Batteries; Farads, Milliohms, and Microhenries. *E. Willihnganz*, C. & D. Batteries, Inc.

Modern Circuit Techniques—III

CP.* Circuit Reliability vs System Reliability in Transistor Switching Circuits—A Survey. *J. J. Suran*, General Electric Co.

CP59-261. Back-Transient Diode Logic. *G. Wolff*, University of Denver.

CP.* Controlled-Current Transistor Logic. *E. Powers, M. Rubinoff*, Philco Corp.

CP59-462. SCTL—A Reliable Version of Transistor Logic Circuitry. *W. E. Slusher, R. L. Jones*, Transitron Electronic Corp.

CP.* Complementary Transistor Resistor Logic. *G. D. Bruce, M. J. Flynn*, International Business Machines Corp.

CP.* Fundamental Considerations of Power Dissipation Limits in Transistor Pulse Circuits. *H. Raillard*, General Electric Co.

Nuclear Power Plants—III

58-531. Electrical Engineering Aspects of the Enrico Fermi Atomic Power Plant. *R. H. Logue*, Power Reactor Development Co. (Re-presented for Discussion only)

CP59-405. Horizontal Pressure Tube Nuclear Reactor—Canadian Approach to Minimum Fuel Cost Using Natural Uranium. *V. V. Mason, S. M. Jones*, Canadian Westinghouse, Ltd.

58-1299. Auxiliary Power System for Nuclear Plants. *R. E. Frick*, Gilbert Associates, Inc.

CP58-1300. Training Simulator for Nuclear Power Plant Reactor Operators. *N. E. Bush*, Westinghouse Electric Corp.

Video Tape Facilities and Television Antennas

CP.* Burbank Video Tape Facilities. *R. Byloff*, NBC.

CP.* CBS New York Video Tape Installation. *K. B. Benson*, CBS.

CP.* Video Automatic Gain Control. *D. Taylor*, RCA.

CP59-459. Traveling Wave Antenna. *M. Siukola*, RCA.

Radio Communications Systems

58-1293. Public Air–Ground Telephone Service Trial. *L. M. Augustus*, Michigan Bell Telephone Co.

58-1292. Dial Telephone Service for Smith Island—An Isolated Community in the Chesapeake Bay. *M. E. Littleton*, The Chesapeake & Potomac Telephone Co. of Maryland.

58-1227. Expansion of Pacific Coast Microwave Network. *R. G. Kuck*, Pacific Telephone & Telegraph Co.

CP59-83. Optimum Design Considerations for Radio Relays Utilizing the Tropospheric Scatter Mode of Propagation. *C. A. Parry*, Page Communication Engineers, Inc.

The Motivation Multiplier in Electrical Engineering Education

CP58-1380. The Profile of an Engineer. *G. D. Lobingier*, Westinghouse Electric Corp.

CP58-1404. Techniques for Motivating Students. *S. R. Warren, Jr.*, Univ. of Pennsylvania; *B. R. Teare*, Carnegie Institute of Technology.

CP58-1370. Motivation through Challenge. *W. C. Johnson, P. R. Clement*, Princeton University.

CP.* Opportunity and Responsibility as

Motivators for Engineers. *W. G. Amey*, Leeds & Northrup Co.

CP58-1385. 1,200 Case Studies of Engineering Motivation. *G. E. Moore*, Westinghouse Electric Corp.

Rotating Machinery

58-1304. A Technique of Measuring the Amplitude and Harmonic Content of Surge Voltages in Machine Windings during Switching. *F. A. Scheda*, Westinghouse Electric Corp.

CP59-139. A Surge Generator for Simulating Switching Transients in Induction Motors. *F. A. Scheda*, Westinghouse Electric Corp.

CP58-1310. Tests and Life Expectancy of Generator Windings. *V. S. McFarlin*, Boston Edison Co.

59-137. Switching Transients in Single-Phase Induction Motors with Speed Constant. *P. Venkata Rao*, Indian Institute of Science.

CP59-138. Rotor Impedance Control of the Wound-Rotor Induction Motor. *W. Shepherd, G. R. Slemon*, University of Toronto.

Transmission and Distribution

59-80. A Correlation of the Present with a Proposed Standard Method for RIV Measurements on High-Voltage Devices. *C. J. Miller, Jr.*, The Ohio Brass Co.

59-79. Development of a Square Law Radio Noise Meter—I. *F. J. Trebby*, Kaiser Aluminum & Chemical Corp.

59-94. The Effect of Rain on RIV Characteristics of High-Voltage Suspension Assemblies. *J. Kaminski, B. E. Kingsbury, F. C. Vose*, General Electric Co.

CP.* Determination of Lightning Response of Transmission Lines by Means of Geometrical Models. *F. A. Fisher, J. H. Hagenguth, J. G. Anderson*, General Electric Co.

CP59-275. Response of a 345-Kv Transmission Tower to a Simulated Lightning Stroke. *H. R. Armstrong*, Detroit Edison Co.; *L. O. Barthold, A. J. Schultz*, General Electric Co.

Power System Communications

58-1228. Experience with Broad-Band Carrier Coupling. *H. I. Dobson*, Tennessee Valley Authority.

59-51. Practical Computation of Single-Frequency Coupling Losses for Representative Field Conditions. *H. J. Fiedler, F. C. Krings, D. L. Willer*, General Electric Co.

59-59. A Loop Microwave System Design. *R. H. Davis*, Motorola, Inc.

CP59-432. A New Look in Microwave. *K. Ray*, General Electric.

Rotating Machinery

59-135. Current Loci of Permanent Magnet Synchronous Motors, An Extension of Blondel Theory. *J. F. H. Douglas*, Marquette University.

59-136. A Novel Type of Smoothly Variable Speed A-C Motor Having Widely Adjustable Power Factor Characteristics. *P. K. Charlu*, P.S.G. College of Technology.

CP55-753. Advancements in Synchronous Motor Control and Protection. *J. Baude*, Allis-Chalmers Mfg. Co.

59-112. Differential Leakage of 3-Phase Windings with Consequent Pole Connection. *C. H. Lee*, Westinghouse Electric Corp.

Computers in Nuclear Systems

58-1314. Digital Calculation of Transient Performance of the Primary Coolant System in a Water Reactor. *D. G. Lewis*, General Electric Co.

58-1315. Computational and Experimental Techniques in Nuclear Reactor Design. *W. F. Witzig, M. R. Stuart, L. O. Herwig*, Westinghouse Electric Corp.

CP.* Present Status of Analog Representations of Nuclear Power Systems. *J. M. Gallagher*, Westinghouse Electric Corp.

CP58-1316. Engineering Description of a Water-Moderated Flexible Critical Facility Using Metal Fuel. *E. S. Lembersky*, Westinghouse Electric Corp.

CP.* Shielding Computer Program. *J. T. Martin, J. P. Yalch*, General Electric Co.

Electrical Insulation

58-1205. Thermal Life of Enameled Magnet Wire. Electrical Insulation Committee Working Group Report. *J. F. Dexter*, Chairman.

CP59-116. Study of Thermal Deterioration of Kraft Pulps Using a Mass Spectrometer. *Y. Saito, T. Hino*, Tokyo Institute of Technology.

CP59-115. The Aging of Organic Varnish Films upon Iron Surfaces. *R. W. Nye*, Minnesota Mining and Manufacturing Co.

CP59-468. Comparison of Test Procedures for the Thermal Life Testing of Varnished Glass Cloth. *C. J. Straka, E. W. Lindsay, G. W. Hewitt, T. W. Dakin*, Westinghouse Electric Corp.

CP59-471. Fluidized Coating—A Method of Slot Insulation. *R. H. Thielking, D. L. McClenahan*, Schenectady Varnish Co.

Ceramic Tube Developments

CP59-308. A New Ceramic Triode for VHF Applications. *J. D. Campbell*, General Electric Co.

CP59-437. The *1802-A* Ceramic-Metal Envelope Hydrogen Thyratron. *D. F. Riley*, Edgerton, Germeshausen & Grier, Inc.

CP.* Color Photomicrographic Examination of Electron Tubes. *E. W. Scott*, General Electric Co.

CP59-327. Stacked-Mount Vacuum Tubes with a Choice of Glass or Ceramic Envelopes. *C. F. Douglas*, Sylvania Electronic Products, Inc.

Production and Application of Light

CP.* A Progress Report of the Latest Developments in Equipment and Lighting Techniques. *E. A. Linsday*, General Electric Co.

CP.* Some Aspects of the Problems Concerning Group Replacements of Mercury and Fluorescent Lamps on Street Lighting Systems. *R. C. Wey*, Ohio Power Co.

CP.* Luminaire and Light Conditioning Maintenance for Offices and Factories. *E. I. Creed*, Cleveland, Ohio.

Nonlinear Control Systems

59-218. A Relay-Type Feedback Control System Designed for Random Inputs. *A. M. Hopkin, P. K. C. Wang*, University of California.

59-147. A Study of Nonlinear Systems with Random Inputs. *K. Chuang, L. F. Kazda*, University of Michigan.

59-231 A Stability Criterion for Nonlinear Systems. *Y. H. Ku, A. A. Wolf*, University of Pennsylvania.

CP59-232. Describing Function Measurement with an Electronic Analog Computer. *V. L. Larrowe, M. M. Spencer*, University of Michigan.

59-233. Limit-Cycle Stability Study of a Feedback Control System by a New Describing Function Technique. *H. J. Harrington*, Convair-Astronautics.

Industrial Power Rectifiers

CP59-389. Report of Field Tests on Aluminum Pot Line Rectifier Systems. *C. A. Langlois*, Reynolds Metals Co.; *V. N. Stewart, R. P. Stratford*, General Electric Co.

CP59-254. Some Improvements in High-Speed Circuit Breakers. *C. I. Clausing*, I-T-E Circuit Breaker Co.; *D. I. Bohn*, Asheville, N. C.

CP59-349. Specification of Rectifiers for Electrolytic Plants from the User's Point of View. *W. C. Gardiner, W. J. McCaig, and C. F. Ruyon*, Olin Mathieson Chemical Corp.

CP59-284. Pneumatic Force-Balance Systems for Measuring Cell Line Currents. *H. C. Behrens, B. J. Nankervis*, Dow Chemical Co.

Integrating Instruments

58-167. Statistical Approaches to Selecting Domestic Meters for Test. *L. Dwon, J. A. Morris*, American Electric Power Service Corp.

59-17. A Single-Stator Meter for Two Phases of 4-Wire Y. *E. W. Schwarz*, Sangamo Electric Co.

59-168. Polyphase Meter Connections 30 Years After Woodson. *F. W. Warburton*, New England Power Service Co.

59-165. The Inductronic Electrodynamometer for the Precise Measurement of Voltage, Current, Power Energy. *R. F. Estoppey*, Daystrom, Inc.

59-166. Precision Integrator for D-C Potentials. *J. R. Pallee*, Daystrom-Weston.

The Road to Scientific Supremacy?

CP.* The Navy and Research Progress. *Admiral R. Bennett*, Office of Naval Research.

CP59-276. The Role of Government Research Laboratories. *A. V. Astin*, National Bureau of Standards.

CP59-278. The Outlook on Science in Canada and England. *B. G. Ballard*, National Research Council of Canada.

CP.* The National Academy of Sciences–National Research Council. *D. W. Bronk*, National Academy of Sciences.

Transformers

CP59-438. Tank Pressures Resulting from Internal Explosions. *R. J. Ringlee, N. W. Roberts*, General Electric Co.

CP59-307. Internal Fault Characteristics of Gas Insulated Transformers. *G. Camilli, L. J. Littlejohn, W. A. Wooldridge*, General Electric Co.

CP59-306. A 10,000-Kva, 69-Kv Gas-Insulated Transformer. *G. Camilli*, General Electric Co.

CP59-415. Design, Insulation, and Thermal Performance Characteristics of a 7,500-Kva Vapor-Cooled Transformer. *P. Narbut, A. J. Maslin*, Westinghouse Electric Corp.

Semiconductor Switching Devices—I

58-1249 Theory of Transient Build-up in Avalanche Transistors. *W. Shockley, J. Gibbons*, Shockley Semiconductor Labs.

CP58-1359. P-N-P-N Switches. *J. M. Goldey*, Bell Telephone Labs., Inc.

CP58-1378. Germanium P-N-P-N Switches. *I. A. Lesk*, General Electric Co.

CP58-1223. High-Gain Static A-C Switch. *E. A. Petrocelli*, Westinghouse Electric Corp.

58-1248. A Silicon Controlled Rectifier—Its Characteristics and Ratings—I. *D. K. Bisson, R. F. Dyer*, General Electric Co.

Telegraph Systems

59-37. Telex in New York. *P. R. Easterlin*, Western Union Telegraph Co.

59-154. Properties of Modern Teleprinters with Regard to Signal Transmission. *H. Wusteney*, Siemens and Halske AG.

59-8. A Nonsynchronous System for Mobile Record Communications. *C. H. Stewart II*, Bell and Gosset Co.

59-152. Reperforator-Teletypewriter *TT-195 FG*. *D. F. Frick*, Smith-Corona Marchant, Inc.

58-443. The 83B1 Teletypewriter Selective Calling System. *C. W. Smith*, American Telephone and Telegraph Co., retired; *C. J. Votaw, A. L. Whitman*, Bell Telephone Labs., Inc. (Re-presented for Discussion only)

Training in Communications

CP58-1235. Industry Schools its Engineers.

C. E. Waldner, New York Telephone Co.

58-1152. A New Approach to Training Telephone Engineers. *W. C. Burnett*, Southern Bell Telephone and Telegraph Co.; *L. C. Adams*, Clemson College.

CP58-1323. Telephone Engineering Management Conference. *P. H. Henson*, Lincoln Telephone and Telegraph Co.

CP.* The Evaluation of Engineering Training in Industry. *A. L. Charney*, Bell Telephone Co. of Pennsylvania.

Rotating Machinery

59-25. Evaluation of the Internal Insulation of Generator Coils Based on Power Factor Measurements. *D. A. Findlay*, Saguenay Power Co., Ltd.; *R. G. Brearley, C. C. Louttit*, Aluminum Company of Canada, Ltd.

58-1311. A Utility's Functional Evaluation Tests for High-Voltage Stator Insulation. *A. W. W. Cameron, M. Kurtz*, Hydro Electric Power Commission of Ontario.

58-1312. Experience in Analysis of D-C Insulation Tests for Maintenance Programs. *F. R. Schleif, L. R. Engvall*, U.S. Bureau of Reclamation.

CP58-1391. Accelerated Voltage Endurance Tests. *R. H. Rhudy, H. E. Mazanek*, General Electric Co.

Modern Circuit Techniques—IV

CP.* A Technique for Drift Reduction in Semiconductor Direct-Coupled Circuitry. *T. B. Martin*, Radio Corp. of America; *J. E. Lindsay*, Cornell Aeronautical Laboratories.

CP.* Transistor D-C Amplifiers. *R. H. Okada*, University of Pennsylvania.

CP59-452. A 5-Watt 14-Mc Transistor Transmitter. *J. Sevick*, Bell Telephone Laboratories.

CP.* The Design of Self-Balancing Diode-Ring Modulators and their Extension to Several Unfamiliar Applications. *P. M. Thompson*, Defence Research Telecommunications Establishment.

CP.* Low-Level Silicone Transistor Chopper. *F. Schlereth*, General Electric Co.

CP.* Transistorized Phase Modulator. *C. S. Kim*, General Electric Co.

Transmission and Distribution

59-82. Bundled Conductor Voltage Gradient Calculations. *J. Reichman*, The Hydro Electric Power Commission of Ontario.

59-98. Relationship between Corona and Radio Noise on Transmission Lines Part II—Conductor and Insulator Corona. *T. W. Liao, J. J. LaForest*, General Electric Co.

59-49. Radio Noise Propagation and Attenuation Tests on Bonneville Power Administration McNary-Ross 345-Kv Line. *G. E. Adams, T. W. Liao*, General Electric Co.; *M. G. Poland*, Bonneville Power Administration; *F. J. Trebby*, Kaiser Aluminum and Chemical Corp.

59-95. Wave Propagation Along Unbalanced High-Voltage Transmission Lines. *G. E. Adams*, General Electric Co.

System Engineering

59-225. Theory of Economic Operation of Interconnected Areas. *R. H. Kerr, L. K. Kirchmayer*, General Electric Co.

CP59-239. The Use of Power Transfer Equations To Derive Economic Co-ordination Relationships Expressed as Functions of Voltage Phase Angles. *A. R. Miller*, Lehigh University; *H. R. Koen, Jr.*, Minneapolis-Honeywell Regulator Co.; *J. S. Deliyannides*, Rensselaer Polytechnic Institute.

CP59-408. Measurement of the Transfer Functions in the Electric Power Systems Using Spontaneous Power Variations. *M. Mesarovic*, Massachusetts Institute of Technology; *I. Obradovic*, Institute "Nikola Tesla."

58-952. Economic Complementary Operation of Hydro Storage and Steam Power in the Integrated TVA System. *R. N. Brudenell, J. H. Gilbreath*, Tennessee Valley Authority. (Re-presented for Discussion only)

Switchgear

59-41. The X/R Method of Applying Power Circuit Breakers. *J. E. Skuderna*, U. S. Bureau of Reclamation.

CP59-186. Proposed Revision of American Standard—Alternating-Current Power Circuit Breakers C37.4. AIEE New Working Group on Methods of Rating Power Circuit Breakers.

Rotating Machinery

59-3 An Accurate Method of Calculation of Subtransient Reactances of Synchronous Machines. *K. B. Menon*, Indian Institute of Technology.

59-140. A Hydrostatic Thrust Type Shaft Seal for Hydrogen Cooled Generators. *W. W. Gardner, A. Lehrkind, W. L. Ringland*, Allis-Chalmers Mfg. Co.

CP59-141. Application of the Piecewise Linear Method to the Analysis of Direct-Axis Transient Response of Saturated Alternators. *S. L. Mikhail*, University of California.

58-1151. Development of Device To Protect Turbogenerator from Damage Because of Thrust Bearing Failure. *R. Bruce, C. A. Roberts, K. C. Byram*, Tennessee Valley Authority.

59-121. Modern Large Steam Turbines and Generators. *C. C. Franck, Sr., J. W. Batchelor*, Westinghouse Electric Corp. (Re-presented for Discussion only)

Digital Computer Techniques

CP59-205. Symmetric Switching Functions (Matrix Logic V.) *E. J. Schubert*, Burroughs Corp.

CP59-204. Matrix Algebra of Sequential Logic. *E. J. Schubert*, Burroughs Corp.

CP59-195. Digital Technique for Block Diagram Reduction. *J. D. Ashley, L. P. Matthews*, North American Aviation, Inc.

59-196. System Synthesis with the Aid of Digital Computers. *J. B. Dennis, R. F. Nease, R. M. Saunders*, University of California. (Re-presented for Discussion only)

Electrical Insulation

CP59-371. A New Test Method for Evaluating Fabrication Properties of Sheet Insulation. *J. R. Huntsberger*, E. I. du Pont de Nemours & Co. (Inc.)

CP59-113. Thermal Evaluation of Rigid Electrical Insulating Materials, a Proposed Test Procedure and Problems Related Thereto. AIEE Working Group on Rigid Materials. *K. Wechsler*, Chairman.

58-1167. New Organic Insulation for a 500 C Electrical Equipment. *C. H. Vondracek, E. J. Croop*, Westinghouse Electric Corp.

59-118. Mathematics of Insulation Aging Calculations. *L. C. Whitman*, General Electric Co.; *W. W. Whitman*, Cornell University.

CP.* Parallel Electric Breakdown Tests of Rigid Electrical Insulating Materials in an Oil Medium. *K. Wechsler, M. Riccitiello*, Westinghouse Electric Corp.

Transients in Rectifier Circuits

CP.* Voltage Transients Due to Arc Extinction. *H. C. Steiner, R. W. Strecker*, General Electric Co.

CP59-124. The Effects of Transformer Parameters on Commutation Transients in Rectifier Circuits. *R. P. Massey*, Bell Telephone Labs.

59-149. Transient Voltages in Rectifier Transformers. *B. C. Biega, H. W. Lord*, General Electric Co.

CP59-150. High-Voltage Rectifier Transformer Problems. *T. L. Wilson*, National Cylinder Gas Co.

CP.* R-C Transient Suppression Circuits for Silicon Rectifiers. *R. G. Martin*, Westinghouse Electric Corp.

Theory and Practice of Reactor Control

CP58-1362. A Digital Nuclear Reactor Control System. *E. P. Gyftopoulos*, Massachusetts Institute of Technology, *P. M. Coble*, Stevens, Davis, Miller & Mosher.

CP58-1341. The Effect of Feedwater Control on a Pressurized Reactor. *E. F. Borner*, General Electric Co.

CP.* Automatic Control of Boiling Water Reactors. *M. A. Head*, General Electric Co.

CP.* Variable Moderator Level Control of Boiling Water Reactor. *S. R. Nixon*, American Standard Corp.

CP58-1332. A Stability Study of an Atomic Power Plant. *R. W. Albrecht*, University of Michigan.

Power Systems Communications and Relays

59-58. Staged Fault Tests with Power Line Carrier Transferred Trip Relaying for Line Protection. *D. E. Jones*, Hydro Electric Power Commission of Ontario.

CP.* A 10-Watt All Transistorized Transmitter-Receiver for Pilot Relaying. *T. A. Cramer, P. R. Crooker*, General Electric Co.

58-1190. Protection of Pilot-Wire Relay Circuits. AIEE Subcommittee on Pilot Wires. *J. L. Blackburn*, Chairman.

59-81. Relaying for Synchronous Motor Pull-Out Protection. *A. H. Hoffman, C. Raczkowski, R. B. Squires*, Westinghouse Electric Corp.

Industrial Power Rectifiers

CP59-409. Germanium Rectifiers for Electrochemical Processes. *J. H. Michaels, E. T. Myslinsky*, Columbia-Southern Chemical Corp.

CP.* High-Current Low-Voltage Supply for Nuclear Power. *A. E. Johnson*, A. O. Smith Corp.; *E. J. Diebold*, International Rectifier Corp.

CP59-253. Recent Application of Conversion Equipments to Electrolytic Processes. *K. McCaskill, A. G. Forster*, Hooker Chemical Corp.

Drive Systems for Rolling Mills

CP58-1340. The Electrical Characteristics of a Universal Slabbing Mill. *C. J. Bevan*, Bethlehem Steel Co.

CP58-1401. Industrial Control Designs for a Changing Technology. *P. A. Travisano*, General Electric Co.

CP59-378. Control Equipment for Reversing Hot Mill Main Drives, *G. A. Kaufman*, General Electric Co.

CP.* Operation of Rectifiers in Parallel with Existing Generators to Increase Power for Hot Strip Mill Operation. *G. Eckenstaler*, Allis-Chalmers Mfg. Co.

Semiconductor Switching Devices—II

CP58-1397. High-Current Trinistors. *F. S. Stein, E. W. Torok*, Westinghouse Electric Corp.

CP58-1388. A Silicon High-Current Transistor Switch of Low Saturation Resistance. *D. Navon, P. DeBeurs*, Transitron Electronic Corp.

58-1260. Silicon Controlled Rectifiers from Oxide-Masked Diffused Structures. *R. W. Aldrich, N. Holonyak, Jr.*, General Electric Co.

58-1206. Linear Power Amplifiers Using Dynistors or Trinistors. *F. J. Hierholzer, Jr.*, Westinghouse Electric Corp.

CP58-1347. The Controlled Rectifier in Power Control Applications. *W. D. Cockrell, C. S. Walker, J. D. Harnden, Jr.*, General Electric Co.

58-1234. The Controlled Rectifier—Key to the Continuing Control Renaissance. *J. D. Harnden, Jr.*, General Electric Co. (Re-presented for Discussion only)

Communications in Space

Panel-type presentation and discussion by:

CP.* *Dr. R. L. Shuey*, General Electric Co.
CP.* *Prof. R. M. Fano*, Massachusetts Institute of Technology.
CP.* *J. R. Pierce*, Bell Telephone Labs., Inc.
CP.* *J. H. Vogelman*, Rome Air Development Center.

Telegraph Systems

59-153 More About Nonarmored Submarine Cable. *C. S. Lawton*, Western Union Telegraph Co.
59-85. A Transistorized 20-Channel Carrier Telegraph Terminal. *T. M. Grybowski, W. G. Veith*, The Western Union Telegraph Co.
CP59-316. Error Detecting Servo Correcting Phasing System for Facsimile. *A. G. Cooley, H. Strickholm*, Times Facsimile Corp.
CP59-482. Advances in the Printing Telegraph Art During 1958. *E. F. Watson*, Bell Telephone Labs. (retired)
CP59-291. Advances in the Facsimile Art During 1958. *W. H. Bliss*, RCA Laboratories.

Wire Communication Systems

59-70. Engineering Aspects of TASI. *K. Bullington, J. M. Fraser*, Bell Telephone Labs.
CP.* The Syncroplex Telephone Carrier System. *B. G. Goetsee*, ITT Laboratories.
CP.* Applications and Maintenance Considerations of the *K24* Syncroplex System. *J. W. Halina, G. L. Curtis*, ITT Laboratories.
CP.* A General Description of the *K24* Syncroplex Carrier System. *J. W. Halina, G. L. Curtis*, ITT Laboratories.
59-71. Electrical Protection for Transistorized Equipment. *D. W. Bodle, J. B. Hays, Jr., Bell* Telephone Labs.
CP59-259. A New Field Telephone for Military Use in Four Wire Electronic Switching Systems. *J. L. Faherty*, U.S. Army Signal Research and Development Laboratories; *A. S. Howell*, Stromberg-Carlson Co.

Indicating Instruments

59-161. A Wide-Range Volt-Ampere Converter for Current and Voltage Measurements. *F. L. Hermach, E. S. Williams*, National Bureau of Standards. (Re-presented for Discussion only)
59-158. An Impedance Bridge for Surface Temperature Measurement. *R. J. Mouly*, Corning Glass Works.
59-159. Taut Band Suspensions for 250 Degree Instruments. *M. S. Thomander, R. C. MacIndoe*, Westinghouse Electric Corp.
CP59-125. An Electrical Indicating Instrument Designed to Use Molded Magnet Techniques. *H. Otzmann, Jr.*, Westinghouse Electric Corp.
CP59-406. Advantages and Limitations of Plastic Bonded Magnets. *C. A. Maynard*, Indiana Steel Products Co.
59-22. A Method for Calibration of Precision Voltage Dividers. *C. B. Pinckney*, Hughes Aircraft Co. (Re-presented for Discussion only)

Rotating Machinery

59-142. The Establishment of a Base for for Class *A* Random Wound Motor Insulation Life by AIEE No. 510 Test Procedure and Its Correlation with Field Experience. *R. L. Balke, D. R. Blake*, General Electric Co.
58-1280. Results of Motorette Evaluation of Insulation Systems. *H. P. Boettcher*, A. O. Smith Corp.
CP59-126. A Bridge Circuit for Measuring the Temperature of Alternating Current Energized Windings. *R. E. Seely*, General Electric Co.
CP59-143. Synthesis of Double-Cage Induction Motor Design. *H. E. Jordan*, Reliance Electric & Engineering Co.

Automation in the Soviet Union

Members of the Panel are:

CP.* *S. W. Herwald*, Westinghouse Electric Corp.
CP.* *N. Cohn*, Leeds & Northrup Co.
CP.* *W. E. Vannah*, McGraw-Hill Publishing Co.
CP59-386. *R. J. Kochenburger*, University of Connecticut.
CP.* *E. J. Kelly*, Massachusetts Institute of Technology.

Power System Operation—Maintenance Costs

58-1308. Fundamental Concepts of Incremental Maintenance Costs as Used by Ohio Edison Company. *D. B. Zelenka, R. H. Travers*, Ohio Edison Co.
CP58-1309. Determination of Output Maintenance Costs on the West Penn Electric System. *R. L. Ballentine*, Potomac Edison Co.; *W. S. Schmidt, T. A. Lake*, Monongahela Power Co., *H. T. McCarthy, R. F. Crim*, West Penn Power Co.
58-1187. Application of Digital Computer Technique for Development of the Incremental Maintenance Cost. *F. H. Light*, Philadelphia Electric Co.
58-1336. Report on Present Day Practices of Handling Incremental Maintenance Costs as they Apply to Economic Dispatch of Power. AIEE Working Group on Application of Incremental Heat Rates for the Economic Dispatch of Power, Presented by L. T. Anstine.
Panel Discussion:

CP.* *G. H. McDaniel* Moderator, American Electric Power Service Corp.
CP.* *L. T. Anstine*, Baltimore Gas & Electric Co.
CP.* *W. S. Schmidt*, Monongahela Power Co.
CP.* *R. H. Travers, D. B. Zelenka*, Ohio Edison Co.
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58-1208. The Present Status and Anticipated Progress in the Field of Insulating Materials. *T. D. Callinan*, IBM Corp.

Insulated Conductors

58-305. The St. Lawrence River High Voltage Submarine Cable Crossing, Part II—Experimental Programme and Cable Manufacture. *D. M. Farnham, S. H. Cunha*, Quebec Hydro-Electric Power Commission; *G. B. Shanklin*, Schenectady, N. Y.; *H. D. Short*, Canada Wire & Cable Co. (Re-presented for Discussion only)

CP58-1353. The St. Lawrence River High-Voltage Submarine Cable Crossing, Part III—Installation. *D. M. Farnham, S. H. Cunha*, Quebec Hydro-Electric Power Commission; *G. B. Shanklin*, Schenectady, N. Y.; *H. D. Short*, Canada Wire & Cable Co.

CP58-1354. The St. Lawrence River High Voltage Submarine Cable Crossing, Part IV—Field Tests after Installation and Conclusion. *D. M. Farnham, S. H. Cunha*, Quebec Hydro-Electric Power Commission; *G. B. Shanklin*, Schenectady, N. Y.; *H. D. Short*, Canada Wire & Cable Co.

Protective Devices

59-68. A Report on Performance Characteristics of Lightning Arresters. Working Group of AIEE Lightning Protective Devices Subcommittee of The Protective Devices Committee. *W. F. Griffard*, Chairman.

59-50. New Current-Limiting Gap Extends Valve-Type Lightning-Arrester Performance. *J. W. Kalb, A. G. Yost*, The Ohio Brass Co.

59-60. A New Electrical Research Laboratory. *F. E. Andrews, A. Vitkus*, Hubbard and Co.

59-216. Lightning Arrester Field Test Equipment and Results. *H. Linck*, The Hydro Electric Power Commission of Ontario.

CP59-385. Lightning Protection of Equipment on Multiple Line Buses. *A. H. Knable*, Allis-Chalmers Mfg. Co.

CP59-486. A New Fuse Cutout. *A. C. Westrom*, Hubbard & Co.

CP.* Surge Protection of Unit-Connected Generators. *K. H. Chang, T. B. Thompson*, Oklahoma State University.

Magnetic Amplifiers

59-170. Analysis of a Series-Connected Saturable Reactor with Capacitive Loading and Finite Control Resistance by the Use of Difference Equations. *H. C. Bourne*, University of California; *J. T. Salihi*, Lenkurt Electric Co.

59-169 Graphical Analysis of the Full-Wave Magnetic Amplifier Control Characteristics Affected by Control Circuit Resistance. *K. Murakami, T. Kikuchi*, Tohoku University.

59-171. Analysis of Magnetic Amplifiers without Diodes. *P. R. Johannessen*, Massachusetts Inst. of Technology.

59-172. Analysis of Magnetic Amplifiers with Diodes. *P. R. Johannessen*, Massachusetts Inst. of Technology.

59-173. Recommended Symbols for Magnetic Amplifier Papers, A Report, Theory Subcommittee of AIEE Magnetic Amplifiers Committee, *H. F. Storm*, Chairman. (Re-presented for Discussion only)

Electric Circuit Theory

59-46. Current Distribution in the Cylindrical Source Plane-Electrode Configuration. *W. D. Comstock*, Syracuse University Research Corp.; *E. M. Williams*, Carnegie Institute of Technology.

CP59-111. Capacitance of Parallel Rectangular Cylinders. *J. D. Horgan*, Marquette University.

CP.* Transient Solution of Systems by Multiple Z Transforms. *T. J. Higgins, M. Chen*, University of Wisconsin.

59-266. The Characteristic Impedance and Phase Velocity of a Shielded Helical Transmission Line. *H. S. Kirschbaum*, Battelle Memorial Institute.

59-16. The Optimum Transmission-Line Pulse Transformer. *F. J. Young, E. R. Schatz, J. G. Woodford*, Carnegie Institute of Technology.

59-15. The Transient Response of Tapered Transmission Lines. *F. J. Young, E. R. Schatz, J. B. Woodford*, Carnegie Institute of Technology.

59-264. Spectral Output Of Piecewise Linear Nonlinearity. *O. J. M. Smith* University of California.

59-265. Statistical Spectral Output of Power Law Nonlinearity. *O. J. M. Smith*, University of California.

Railroad Rolling Stock

CP59-245. A Full-Range Two-in-One (Diesel-Electric, Third-Rail) Locomotive. *B. H. Hefner*, General Motors Corp.

CP59-248. Prototype Alternating-Current Multiple-Unit Train of the Pennsylvania Railroad. *K. H. Gordon*, The Pennsylvania Railroad Co.; *V. F. Dowden*, The Budd Co.; *E. W. Ames*, Westinghouse Electric Corp.

CP59-246. Control for an 8,500-hp Gas Turbine-Electric Locomotive. *R. M. Smith, W. B. Zelina*, General Electric Co.

Industrial Control

58-1166. The Application of Shift Register Techniques to Materials Handling.

H. C. Diener, Jr., Westinghouse Electric Corp.

59-91. New Methods of Simplifying Boolean Functions. *R. L. Howard*, Westinghouse Electric Corp.

CP58-1284. Logic Design Techniques of Static Switching Control for Transfer Machines. *J. W. Stuart*, Industrial Nucleonics Corp.; *R. A. Manning*, Westinghouse Electric Corp.

58-1285. Static Control in Automatic Warehousing. *L. L. Bosch, A. J. Fanthorp*, Bosch & LaTour; *J. W. Stuart*, Industrial Nucleonics Corporation. (Re-presented for Discussion only)

Substation and Switchgear

59-238. Design Features of 40,000-Kva Underground Distributing Station. *C. M. Short, F. C. Osborn*, Los Angeles Dept. of Water and Power.

59-42 Large Metropolitan Distribution Substations. *T. D. Reimers*, Consolidated Edison Co. of N. Y., Inc.

CP59-202. Lombard 66-13.2 Kv Substation in Central Philadelphia. *J. A. Krawchuk*, Philadelphia Electric Co.

CP.* New 13.8-Kv 1,000-Mva Air Magnetic-Type Power Circuit Breaker with Stored Energy Operating Mechanism in Metal-Clad Switchgear. *R. M. Korte, W. T. Sharp, R. E. McDaniel*, General Electric Co.

Chemical Processes and Petroleum Industries

CP.* The Use Of Aluminum Conduit in Industrial and Chemical Plants. *E. G. Fox*, Kaiser Aluminum and Chemical Sales Inc.

CP58-1368. The Development of Reliable Electrical Systems in Petroleum Refineries. *J. C. Howard*, Standard Oil of Indiana.

Group Dynamics Discussion on Designing for Reliability of Power Systems. Discussion Leader L. B. Eddy.

Electronic Switching Systems—II

CP.* A High-Speed Barrier Grid Store. *T. S. Greenwood, R. E. Staehler*, Bell Telephone Labs., Inc.

CP59-337. Application of Breakdown Devices to Large Multistage Switching Networks. *T. Feldman, J. W. Rieke*, Bell Telephone Labs., Inc.

CP59-335. A High-Speed Line Scanner for Use in an Electronic Switching System. *A. Feiner, L. F. Goeller*, Bell Telephone Labs., Inc.

CP59-347. A Signal Distributor for Electronic Switching Systems. *L. Freimanis*, Bell Telephone Labs., Inc.

CP59-450. Functional Design of a Stored Program Electronic Switching System. *H. N. Seckler, J. J. Yostpille*, Bell Telephone Laboratories, Inc.

Feedback Control Systems—II

59-197. Effect of Closed-Loop Transfer Function Pole and Zero Locations on the Transient Response of Linear Control Systems. *O. I. Elgerd*, University of Florida; *W. C. Stephens*, U.S. Army Combat Surveillance Agency.

59-255. Evaluation of Transient System Response. *F. P. de Mello*, General Electric Co.

59-198. The Optimum Control of Multi-Actuator Systems. *I. McCausland*, University of Toronto.

59-214. The Linear Least Squares Synthesis of Multivariable Control Systems. *R. C. Amara*, Stanford Research Institute.

58-796. Transfer Functions of Loaded Synchronous Machine. *D. Hamdi-Sepen*, Technical University of Istanbul. (Re-presented for Discussion only)

58-1083. Application of Continuous System Design Concepts to the Design of Sampled Data Systems. *S. F. Schmidt*, Ames Aeronautical Lab. (Re-presented for Discussion only)

CP.* Classified Bibliography on Feedback Control Systems: Part IV, Obtaining Transient Response from Frequency Response. *T. J. Higgins*, University of Wisconsin.

CP.* Classified Bibliography on Feedback Control Systems: Part V, Obtaining Frequency Response from Transient Response. *T. J. Higgins*, University of Wisconsin.

CP.* Classified Bibliography on Feedback Control Systems: Part VI, Time-Lag Systems. *T. J. Higgins*, University of Wisconsin.

CP.* Classified Bibliography on Feedback Control Systems: Part VII, Stability Theory. *T. J. Higgins*, University of Wisconsin.

Engineering Science and the Demands of Industry

Panel Members are:

CP59-353. *H. W. Gouldthorpe*, General Electric Co.

CP.* *S. Seely*, Case Institute of Technology.

CP.* *D. B. Sinclair*, General Radio Co.

CP.* *H. H. Skilling*, Stanford Univ.

CP.* *D. K. Reynolds*, Moderator: Seattle University.

Montreal Sponsors Program on Industrial Power Systems

The Montreal, Quebec, Section of AIEE recently sponsored a five-session program concerning Industrial Power Systems. R. L. Gladwell, Aluminum Company of Canada, organized the program and R. A. Boyd, Quebec Hydro-Electric Commission, was chairman of the sessions. Mr. Boyd is past chairman and Mr. Gladwell is on the Executive Committee of the Montreal Section. The main object of these sessions was to promote better knowledge of power systems in industrial plants.

The sessions were held on Monday evenings at 2-week intervals which started October 20, 1958, at the Quebec Hydro auditorium. Each session consisted of a 1-hour presentation followed by a coffee break and then about an hour of discussion. Copies of the AIEE Red Book publication "Electric Power Distribution for Industrial Plants," on which the course was based, were distributed to all registrants. Total registration was 260 with an average attendance of close to 200 per session.

The sessions were presented by R. A. Blount, Canadian General Electric; A. Uretsky, English Electric Canada; and D. V. Fawcett, Canadian Westinghouse Co. Ltd. Topics covered were system planning, fault calculations, co-ordination of overcurrent protective devices, system grounding, and selection of electrical power apparatus.

The same five sessions were also presented on successive Tuesday evenings to

VIEW OF AUDIENCE attending one of the five sessions of a program on Industrial Power Systems sponsored by the Montreal Section of the Institute. R. L. Gladwell, Aluminum Company of Canada, organized the program, and R. A. Boyd, Quebec Hydro-Electric Commission, served as chairman of the sessions.

D. V. FAWCETT, a member of the AIEE Industrial and Commercial Power Systems Committee, presented a session on co-ordination of overcurrent protective devices.

37 persons registered from the St. Maurice Valley AIEE Section in Three Rivers, Quebec.

Report of Nominees for Institute Offices

At its meeting held February 2, 1959, the AIEE Nominating Committee selected the following official nominees for election to Institute offices for terms beginning August 1, 1959.

For President:

J. H. Foote, chief engineer, Commonwealth Associates, Inc., and director of engineering, Commonwealth Services, Inc., Jackson, Mich.

For Vice-Presidents:

D. L. Greene, assistant chief electrical engineer, Gilbert Associates, Inc., Reading, Pa. (District No. 2)

J. W. Davis, outside plant engineer, Southern Bell Telephone & Telegraph Company, Atlanta, Ga. (District No. 4)

M. H. Kight, chief, electrical branch, USBR, Denver Federal Center, Denver, Colo. (District No. 6)

G. T. Harness, associate dean of engineering and electrical engineering professor, University of Southern California, Los Angeles, Calif. (District No. 8)

Rene DuPuis, commissioner, Quebec Hydro-Electric Commission, Montreal, Que., Canada (District No. 10)

F. S. Bacon, Jr., P.O. Box 58, Winchester, Mass. (District No. 12)

For Directors:

Hendley Blackmon, engineering manager, association activities, Westinghouse Electric Corporation, Pittsburgh, Pa.

E. I. Green, vice-president, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

S. M. Osthagen, manager, Allis-Chalmers Manufacturing Company, Providence, R. I.

The Nominating Committee, in accordance with the Constitution and Bylaws, consists of one representative of each geographical District, one representative of each Technical Division, and other members chosen by and from the Board of Directors not exceeding in number the number of Technical Divisions.

The Constitution and Bylaws of the Institute require publication in *Electrical Engineering* of the nominations made by the Nominating Committee. Provision is made for independent nominations as indicated in the following excerpts from the Constitution and Bylaws:

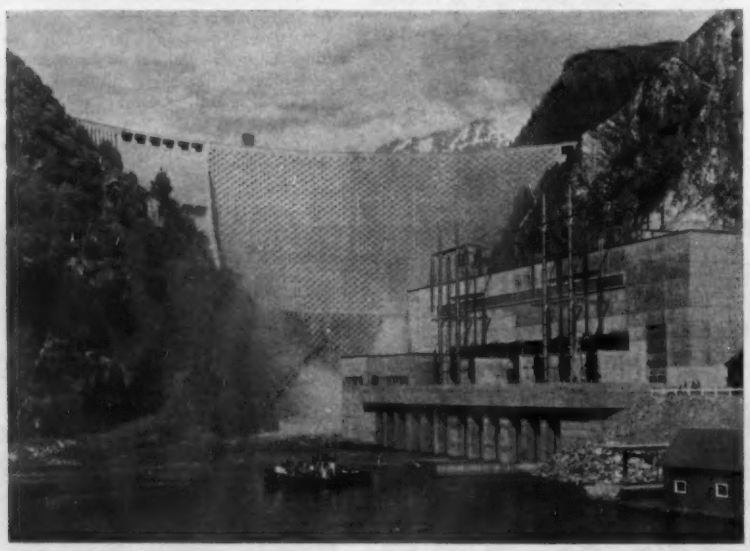
Constitution: C33. Independent nominations may be made by a petition of twenty-five (25) or more corporate members sent to the Secretary when and as provided in the Bylaws; such petitions for the nomination of Vice-Presidents shall be signed only by members within the District concerned.

Bylaws: B28. Petitions proposing the names of candidates as independent nominations for the various offices to be filled at the ensuing election, in accordance with C33 (Constitution) must be received by the Secretary of the Nominating Committee not later than March 15 of each year, to be placed before that committee for the inclusion in the ballot of such candidates as are eligible.

On the ballot prepared by the Nominating Committee in accordance with the Constitution and sent by the secretary to all qualified voters on or before April 15 of each year, the names of the candidates shall be grouped alphabetically under the name of the office for which each is a candidate.

A list of members of the Nominating Committee appeared in the February 1959 issue of *Electrical Engineering*, pp. 178 and 180.

To enable those institute members not acquainted personally with the nominees to learn something about their engineering careers and their qualifications for the Institute offices to which they have been nominated, brief biographic sketches are included in the "AIEE Personalities" columns of this issue.



SEATTLE CITY LIGHT'S 360,000-kw Ross Powerhouse with Ross Dam in the background will be visited during the AIEE Summer and Pacific General Meeting. Each of the four gigantic generators, although rated at 90,000 kw, can produce approximately 112,000 kw, giving the plant a maximum peaking capability with full reservoir of 450,000 kw. Ross Dam 540 feet high and the fifth highest dam in the world, is the key structure of Seattle City Light's Skagit Project. Arching 1,300 feet from wall to wall of the river canyon, it impounds 1.4 million acre-feet of water in a lake 24 miles long, extending into Canada. The waffle-like construction on the face of the dam is designed for future enlarging of the structure. If the dam is raised, as contemplated, another 125 feet, additional concrete will be interlocked with the 5-foot square depressions to thicken the base. The boat in the foreground carries a group of tourists visiting the project.

Recipients of Lamme Medal Announced

The Lamme Medal for 1958 has been awarded jointly to P. L. Alger and Sterling Beckwith. The same citation will be used for each of the recipients:

> "In recognition of their contributions to the art and science of design and application of rotating electric machines."

The presentation ceremony will take place on Monday, June 22, 1959, in Seattle, Wash., during the AIEE Summer and Pacific General Meeting.

The biographies of the recipients will appear in the June 1959 issue of *Electrical Engineering*.

Plans for AIEE Summer and Pacific General Meeting

Are you planning to attend AIEE's Summer & Pacific General Meeting in Seattle, Wash., June 22-26?

Treat your family to this Vacationland Paradise; here are a few of the activities planned:

A. Cruise on Puget Sound climaxed with a salmon barbecue.

B. For the outdoor fishing enthusiasts, a salmon fishing trip to Westport, nationally renowned for successful salmon runs and derbys. Facilities available for having your salmon canned, smoked, or shipped in ice via rail express to any part of the U. S.

C. Participate in a sailing race on beautiful Lake Washington.

D. Aerial cruise Northwest hydroelectric plants.

E. Visit Scott Paper Company's new pulp mill and Weyerhaeuser Timber Company's plant—wood from logs to boards and presto-logs.

F. Visit Boeing Airplane Company's facilities. See wind tunnel testing, new sub-

sonic *707* airliner in construction and Boeing's *B-52*, America's first line defense bomber.

G. See virgin forests and lakes on a trip to Seattle City Light's Ross Dam located in the Upper Skagit region.

For your technical interests there will be noted speakers in their fields of occupation, and a guaranteed paper for almost every phase of the electrical industry.

For those interested in air transportation, the Air Transportation Committee will hold concurrently a meeting which promises a minimum of 100 stimulating presentations with the general theme "Electricity in Space."

Nominations Requested for 1959 Elmer A. Sperry Award

The award was established in 1955 in honor of Elmer A. Sperry and is awarded annually to an individual or groups of individuals in recognition of "A distinguished engineering contribution which, through application in actual service, has advanced the art of transportation whether by land, sea, or air." Recipients are selected by a Board representing the AIEE, American Society of Mechanical Engineers, Society of Automotive Engineers, and Society of Naval Architects and Marine Engineers. Nominations are to be made on a form which may be procured from the Secretary of the Professional Development and Recognition Department, AIEE Headquarters, 33 W. 39th St., New York 18, N.Y.

Section Participates in Program for Students

On January 24, the Philadelphia Section of AIEE sponsored a program on electrical engineering as part of a series of six weekly career sessions for high school students in the Metropolitan Philadelphia area. The sessions at the University of Pennsylvania, Temple University, Drexel Institute of Technology, The Franklin Institute, and the Philadelphia Water Works were under the supervision of the Philadelphia Engineering and Technical Societies Council representing over 20 of the area's technical groups.

The session devoted to electrical engineering, held at the University of Pennsylvania, was attended by 180 students and featured talks and demonstrations by C. T. Pearce, Westinghouse Electric Corporation, on "An Electrical Engineering Career" and A. W. Duerig, Bell Telephone Company of Pennsylvania, on "Electronic Brains." A lengthy question and answer period followed the formal portion of the program.

Directing AIEE participation in the program was H. W. Sommer, Jr., Bell Telephone Company of Pennsylvania, chairman of the Section's Secondary Schools Committee, and G. W. Gordon, Philadelphia Electric Company, Committee vice-chairman. They were assisted by O. A. Huntsman, General Electric Company, C. B. Mansky, Burroughs Corporation; R. F. Schwartz, University of Pennsylvania; and A. J. Williams, Leeds & Northrup Company. Another AIEE member, E. M. Callender, Budd Company, handled the over-all arrangements for the series in his capacity as vice-chairman of the Engineering Councils' Student Guidance Committee.

Cement Industry Conference Allentown, Pa., April 14-16

The first AIEE Conference covering electrical problems in the cement industry, sponsored by the Cement Industry Subcommittee of the General Industry Applications Committee, will be held at the Americus Hotel in Allentown, Pa., April 14-16, 1959. This area represents concentration of the cement industry. The Lehigh Valley Section is acting as host for the Conference.

Papers will be presented by well-known and qualified authors in the industry. These papers will be available in bound form for all those attending, with registration fee of $7.50 in advance and $9.00 at door.

The tentative technical program for the AIEE Cement Industry Technical Conference follows.

Tuesday, April 14

6:00 p.m. to 9:00 p.m. Registration

Wednesday, April 15

8:30 a.m. to 5:00 p.m. Registration

10:00 a.m. General Session

W. A. Allan, chairman, presiding

10:30 a.m. Electric Power Distribution Session

R. P. Scott, moderator

Principles of Electric Power Distribution System in Lehigh's Miami Plant. *J. F. Hower*, Lehigh Portland Cement Co.; *A. C. Lordi*, Westinghouse Electric Corp.

Principles of Electric Power Distribution Systems in Crusher and Quarry Departments. *S. C. Cooke*, General Electric Co.; *R. C. White*, McDonald Engineering Co.

12:30 p.m. Lunch

2:00 p.m. Electric Drives Session

J. A. Allan, moderator

Cement Plant Drives. *W. J. Lefferts*, Allis-Chalmers Mfg. Co.

Selection of Electric Equipment for Ball Mill Drives. *E. A. E. Rich*, General Electric Co.

7:00 p.m. Banquet—Main Ballroom, Americus Hotel

R. E. Stroppel, toast master

Address by C. S. Crawford, president, Whitehall Cement Manufacturing Co.

Thursday, April 16

8:30 a.m. to 12:00 Noon Registration

8:30 a.m. Forum on "Present Status of Automation in Cement Industry"

E. A. E. Rich, Moderator

Sensing System for Ball Mill Feeders. *W. F. Henrick*, Universal Atlas Cement Co.

Kiln Burning with Closed Circuit TV. *W. I. McCord*, Diamond Power Specialty Corp.

Controlling Blending of Raw Materials. *D. A. Johnson*, American Cement, Riverside Div.

X-ray Spectrograph Chemical Analysis of Raw Materials and Clinker. *F. J. Anderson*, American, Marietta, Dragon

Use of Gamma Ray Gauge in Monitoring Slurry Feed to Kiln. Use of Thermocouples in Measuring Rotating Kiln Temperatures. *J. A. Allan*, St. Lawrence Cement Co.

11:30 a.m. Lunch

12:15 p.m. Board Buses for Inspection Trips.

Plans for the future include a Conference on the same subject in Milwaukee, Wis., November 1960.

DEMONSTRATION of basic computer principles to high school students by AIEE members of the Philadelphia Section: (*left to right*) A. W. Duerig, H. W. Sommer, Jr., T. J. McCarthy, all of Bell Telephone Company of Pennsylvania.

Cleveland Will Be Scene of Appliance Technical Conference

The 10th Annual Appliance Technical Conference, sponsored by the Domestic Appliances Subcommittee of the AIEE Domestic and Commercial Applications Committee, will be held at the Hotel Manger, Cleveland, Ohio, on May 18-19, 1959.

An indication of increasing recognition of the importance of this annual Conference can be measured by the fact that the attendance for the 1958 Conference in Chicago, Ill., showed an increase of over 30% over the 1957 Conference in Detroit, Mich.

The program committee canvassed a broad group of engineers throughout the appliance industry before planning the program that will be beneficial to the engineering profession in all major segments of the appliance industry, including cooking and heating, home laundry, air conditioning, small appliances, and other specialized products. The point has been stressed by the committee membership that *all* appliance engineers (United States, Canada, and other countries) are invited to attend, irrespective of whether they are members of AIEE. The purpose of the Conference is to develop industry-wide benefit.

Two groups that have been very active in sponsoring the 1959 Appliance Technical Conference are the Cleveland Section of AIEE and the Single-Phase and Fractional Horsepower Motors Subcommittee of AIEE.

Representing the Cleveland Section as local chairman of the Conference is E. G. Merrick, General Electric Company; the Fractional Horsepower group is represented by L. C. Shaefer, Century Motors, Inc., St. Louis.

Appliance engineers or management men requiring additional information on the 1959 Conference should write direct to M. A. Fuller, Chairman, AIEE Subcommittee on Domestic Appliances, c/o Whirlpool Corporation, 300 Broad St., St. Joseph, Mich.

The tentative technical program for the Conference follows.

Monday May 18

Morning Session, 9:30 a.m.

Presiding: M. A. Fuller, chairman, AIEE Domestic Appliance Subcommittee, Whirlpool Corp

Welcome Address: Henry Martin, chairman, Cleveland Section, AIEE, Martin-Retteger Inc.

Keynote Address: O. H. Yoxsimer, Westinghouse Electric Corp.

A Theory on Dynamic Surface Tension in Home Laundry Solutions. *Dr. Gail Cutler,* Whirlpool Corp.

Polycrystalline Ceramics with Unique Physical, Thermal, and Electrical Characteristics. *G. W. McClellan,* Corning Glass Works

Afternoon Session, 1:15 p.m.

Presiding: B. F. Parr, vice-chairman, AIEE Commercial and Domestic Applications Committee, Westinghouse Electric Corp.

Current Studies of the Peltier Effect. *J. S. Shilliday,* Battelle Memorial Institute

Applying Computer Techniques to Appliances. *Richard Prucha,* General Electric Co.

A tour of Nela Park of the General Electric Company.

Applying Lighting Techniques to Appliances. *W. R. Stevens,* General Electric Co.

Tuesday, May 19

Morning Session, 9:00 a.m.

Presiding: William Vermuelen, General Electric Co.

Electrical Controls for the Parameters of Combustion. *James Wright,* White-Rodgers, Inc.

An Automatic Meat Probe Control. *C. J. Holtkamp,* Westinghouse Electric Corp.

An Automatic Oven Range Timer. *W. R. Buechler,* General Electric Co.

Overheat Protection of Electric Motors. *A. T. White,* Spencer Thermostat Division, Metals and Controls Corp.

LAUNCHING of Mace missile produced by The Martin Company, one of the plants to be visited during the Middle Eastern District Meeting of the AIEE in Baltimore, Md., May 19-21, 1959.

Soviet Science

PERGAMON INSTITUTE announces the publication of a *News Bulletin* listing translated titles of articles published in recent issues of the Soviet journal "Elektrichestvo" (Electric Technology). This Bulletin is available free of charge to members of the AIEE. Members wishing to take advantage of this offer should write to: ELT Bulletin Pergamon Institute, 122 E. 55th St., New York 22, N. Y.

Afternoon Session, 1:30 p.m.

Presiding: Vic Petchul, Watson Publications, Inc.

Motor Insulation Performance in the Home Laundry Equipment Environment. *Los Dogger,* Whirlpool Corp.; *Don Mohrman,* General Electric Co.

A Motor Design for a Specialized Application. *A. G. Ostrognai,* General Electric Co.

An Engineering Appraisal of Standards Program. *T. H. Cline,* Newark Stove Co.; *W. R. Milby,* Detroit-Edison

In addition, there will be an opportunity to sign up for tours of the A. G. A. Testing Laboratories in Cleveland.

District Meeting To Feature Papers from Foreign Nations

Finalization of the technical papers program for Middle Eastern District Meeting in Baltimore, Md., May 19-21, discloses that authors will represent not only this country but foreign nations as well. Through special arrangement, a two-part paper on power distribution will be presented from Paris, France.

In the opposite direction, geographically and categorically, a paper on satellite tracking will be offered by an author from Anaheim, Calif. Over-all, there will be papers from many parts of this country in excess of 125 covering 20 diversified subjects. Also, the National Committee on Engineering Education will hold a special session.

Because of the astounding quantity of papers, there will be six sessions operating simultaneously for five half-days. One additional half-day will be devoted to a general session, featuring world-renowned speakers.

Inasmuch as Baltimore is the nucleus for many diversified industries and installations cognizant of the importance of electric power, informative inspection trips to many of these sites have been arranged.

So that the wives of attending conferees may participate in this meeting, "koffee klatches," scenic tours, including a trip to historic Annapolis featuring a full-dress review at the United States Naval Academy, will fill their hours during the daily sessions. A ladies dinner and card party has been arranged for the evening that the men attend a buffet and smoker. Another

evening will feature a gala Dinner-Dance.

Headquarters for this event will be the Lord Baltimore Hotel, offering outstanding facilities for sessions, sojourning, and social sumptuousness. Participation will be a professional plaudit.

Los Angeles Section Honors Past Chairmen

Past chairmen were the guests of honor at the December dinner meeting, during which the Los Angeles Section showed its gratitude for the excellent guidance these gentlemen have given the Section. The following past chairmen were present at the meeting: 1923-24, E. R. Stauffacher; 1924-25, C. A. Heinze; 1928-29, H. L. Caldwell; 1930-31, H. W. Hitchcock; 1933-34, A. P. Hill; 1934-35, Fred Garrison; 1935-36, O. W. Holden; 1939-40, M. A. Sawyer; 1942-43, T. M. Blakeslee; 1943-44, L. F. Hunt; 1944-45, P. L. Johnson; 1947-48, H. D. Strong; 1948-49, Bradley Cozzens; 1949-50, E. L. Bettannier; 1950-51, J. H. Vivian; 1952-53, E. W. Rockwell; 1953-54, C. A. Wells; 1954-55, G. T. Harness; 1955-56, W. S. Peterson.

The speaker for the evening was J. C. Romanovsky, head of air monitoring, Air Pollution Control District, County of Los Angeles, Air Analysis Division. The speaker discussed the problems of smog and its related problems of measuring and monitoring the atmosphere and the contaminants.

AIEE Los Angeles Section officers discuss air pollution with Mr. Romanovsky, head of air monitoring for the County of Los Angeles. Shown (left to right) are: Robert Milmoe, secretary-treasurer; E. D. Barcus, chairman; Mr. Romanovsky, speaker; Fred Foulon, vice-chairman.

Stanart Photo

Electric Heating Conference April 14-15, Philadelphia, Pa.

The 4th Biennial Conference on Electric Heating, sponsored by the AIEE Electric Heating Committee and hosted by the Philadelphia Section of AIEE will be held April 14-15 in the Bellevue-Stratford Hotel, Philadelphia, Pa. It is a Conference for users, practical rather than theoretical, covering process heating applications in industry, to meet today's production requirements.

The papers and discussions will cover the many advances which have taken place in this field, including modern trends in electric furnaces, mass heating by induction for high production, radiant heating, frequency multiplier equipment, temperature control systems, dielectric heating, and foreign equipment. These are only 7 of a total of 17 discussion provoking papers being presented.

A bound book containing the papers to be presented at the Conference will be included as part of the registration fee.

Tuesday, April 14

8:00 a.m. Registration—Bellevue-Stratford Hotel

9:30 a.m. Welcome

Presiding: F. T. Chesnut, chairman, AIEE Electric Heating Committee.

"A Welcome:" G. B. Schleicher, Philadelphia Electric Company, chairman, Philadelphia Section, AIEE

9:50 a.m. First Session

Chairman: W. C. Rudd, New Rochelle Tool Corporation

Growth of Electric Heat. *M. I. Allen,* Philadelphia Electric Company

Modern Trends in Electric Furnaces. *J. E. Friess, G. A. Kovaka,* General Electric Company

Applications of Dielectric Heating. *W. H. Hickok,* Girdler Process Division, Chemetron Corp.

Mass Heating by Induction for High Production. *J. M. Edwards,* Westinghouse Electric Corp.

12:00 Noon Luncheon

1:30 p.m. Second Session

Chairman: C. A. Tudbury, vice-chairman, AIEE Electric Heating Committee

Radiant Heating. *I. J. Barber,* The Fostoria Pressed Steel Corp.

Radiant Heating for Missile and Aircraft Structural Testing. *R. D. Ross,* National Aeronautics and Space Administration

Metallurgical Treatments in Electrode-Type Salt Bath Furnaces. *Q. D. Mehrkam,* Ajax Electric Co.

High Frequency Resistance Heating. *W. C. Rudd,* New Rochelle Tool Corporation

Frequency Multiplier Equipment. *L. R. Hanes,* Induction Heating Corporation

6:30 p.m. Banquet—Bellevue-Stratford Hotel

8:00 p.m. Evening Session

Presiding: F. T. Chesnut

Address: "Two Modern Miracles," A. S.

Conference Papers Open for Discussion

Conference papers listed below have been accepted for AIEE *Transactions* and are now open for written discussion until April 27. Duplicate double-spaced typewritten copies of each discussion should be sent to E. C. Day, Assistant Secretary for Technical Papers, American Insitute of Electrical Engineers, 33 West 39th St., New York 18, N. Y., on or before April 27.

58-210 **A Recommended Program for Resistance Welding Instrumentation.** *A. Dixon*

58-1057 **Electrical Features of the Four Corners Pipe Line.** *J. J. Sonnier, H. N. Siler*

58-1235 **Industry Schools Its Engineers.** *C. E. Waldner*

58-1257 **Coolant Instrumentation for Pressurized Water Reactor Power Plants.** *J. J. Lihota, C. B. Hoppa*

58-1319 **A Rod Position Indication System for Pressurized Reactors.** *R. C. Floyd, J. F. Reuther*

59-247 **Improved D-C High-Potential Testing of Insulation Systems in Low- and Medium-Voltage D-C Equipment.** *A. M. Odok, T. M. Soelaiman*

Preprints may be purchased at 40¢ each to members, 80¢ each to nonmembers, if accompanied by remittance or coupons. Please order by number and send remittance to: AIEE Order Department, 33 West 39th St., New York 18, N.Y.

Barnes, Bell Telephone Company of Pennsylvania

Wednesday, April 15

9:30 a.m. Third Session

Chairman: C. P. Bernhardt, Westinghouse Electric Corporation

Electric Furnace Operation in the Heavy Forging Industry. *H. H. Casey,* Midvale-Heppenstall Co.

The Utilities Look at Electric Heat. *A. D. Spillman,* Philadelphia Electric Company

Choosing a Temperature Control System for an Electrically Heated Process. *R. S. Day,* Leeds & Northrup Co.

Job Shop Induction Heating. *Charles Hoffman,* Inductioneering Company

12:00 Noon Luncheon

1:30 p.m. Fourth Session

Chairman: K. J. Sorace, The Lamson & Sessions Company

Heavy Steel Production with Induction Heating. *C. N. Howell,* Magnethermic Corp.

Foreign Induction Heating Equipment. *G. A. Jelnio,* ACEC Electric Corp.

Quenching Practices with Induction Heating. *G. H. Ledl,* The Ohio Crankshaft Company

AIEE, ASME, and IRE Plan Joint Automation Conference

A conference to explain and evaluate the use of automatic controls in such diverse applications as banking, steel manufacture, sorting of mail, and railroading, will be held in Chicago, Ill. May 11-13 1959. It will be sponsored jointly by AIEE, The American Society of Mechanical Engineers (ASME), and the Institute of Radio Engineers (IRE).

According to the advance program, the meeting known as the 2nd Annual Joint Conference on Automatic Techniques will avoid the complex engineering problems usually associated with automation. It will cover instead, progress now being made in automatic controls and ways in which they may be applied to any industry.

Attendance at the Conference, which is open to any interested person, is expected to exceed 500. Sessions will be held at the Pick Congress Hotel in Chicago.

Copies of the final program may be obtained by writing to F. D. Snyder, c/o Westinghouse Electric Corporation, 40 Wall St., New York 5, N. Y.

Details of the tentative technical program follow:

Monday, May 11

9:30 a.m. Automatic Techniques in Steel Making

Application of Data Logging and Programming Techniques to Steel Mill Processes. *R. W. Barnitz,* Jones & Laughlin Steel Corp.; *G. E. Terwilliger,* General Electric Co.

Shaping Steel in a Programmed Mill. *H. G. Frostick,* U.S. Steel Corp.

Productivity Improvement through Automatic Control Techniques. *C. Zimmermann,* American Steel & Wire Div., U.S. Steel Corp.

2:00 p.m. Automatic Techniques in Manufacturing

CP59-516 Financial Justification of Capital Equipment. *W. W. Kuyper,* General Electric Co.

Application of Numerical Control for Automatic Manufacturing in General Industry. *W. E. Brainard,* Kearney & Trecker Corp.

Static Control and Automatic Transmissions. *C. N. Bell, Ivan Hosek,* Ford Motor Company

Tuesday, May 12

9:30 a.m. Automatic Business Data Handling

Automatic Techniques in Banking. *B. W. Taunton,* First National Bank of Boston

High-Speed Bank Automation. *Warren Price,* General Electric Co.

Data Processing—Its Role in Administration. *J. D. Gallagher,* Sylvania Electric Products, Inc.

2:00 p.m. Automatic Techniques in Sorting and Handling

Automation in Railroading. *V. E. McCoy,* Chicago, Milwaukee, St. Paul & Pacific Railroad Co.

Mail-Flo System Speeds the Mail. *S. C. Skeels,* Office of Research & Engineering, U.S. Post Office Department

Mechanization of the Job Shop. *W. Willetts,* Western Electric Co., Inc.

Wednesday, May 13

9:30 a.m. Automatic Techniques in the Processing Industries

Data Gathering and Continuous Chemical Processing. *P. D. Schnelle,* E. I. du Pont de Nemours & Co. (Inc.)

Use of Data Logging in Chemical Processing. *G. P. Russell, T. J. Shuff,* Monsanto Chemical Co.

An Optimizing Control for the Processing Industries. *D. A. Burt,* Westinghouse Electric Corp.

2:00 p.m. Plant Visit

AIEE Richland Section

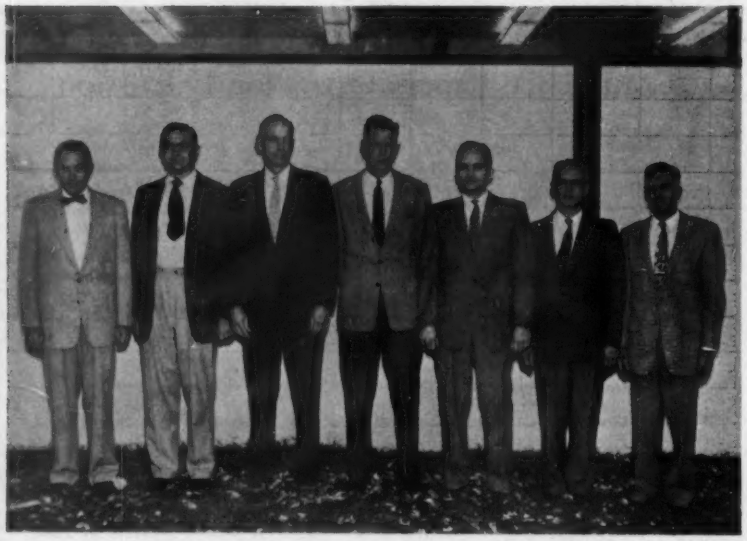
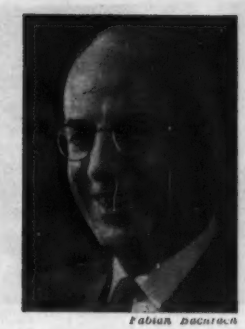


Photo by Clark Mace, Jr.

RESPONSIBLE for the AIEE Richland (Wash.) Section's outstanding achievements in the Member-Gifts Campaign for the new United Engineering Center are: (*left to right*) L. P. Reinig, division captain; C. M. Salina, division captain; H. A. Carlberg, chairman; C. R. Bergdahl, division captain; R. C. Hoffman, division captain; O. Mageehon, finance chairman; and W. W. Kliebenstein, finance chairman. Other division captains not shown in the picture are: C. T. Robinson, division captain, Walla Walla; R. L. Earnheart, division captain, McNary; D. S. Picatti, division captain, Yakima; J. G. Picatti, division captain, Yakima; and F. J. Mollerus, chairman, Survey Committee.

Bimonthly Publications

The bimonthly publications, *Communication and Electronics, Applications and Industry,* and *Power Apparatus and Systems* contain the formally reviewed and approved numbered papers presented at General and District meetings and conferences. The publications are on an annual subscription basis. Members may receive one subscription to any *one* of the bimonthlies for $2.50. The balance of the annual $5.00 subscription price will be paid by application of his annual dues for the year of the subscription. (Members may not reduce the amount of their dues payment by reason of nonsubscription.) Additional member subscriptions will be at the rate of $5.00. Nonmembers may subscribe on an advance annual subscription basis of $8.00 each (plus 50¢ extra for foreign postage payable in advance in New York exchange). Single copies, when available, are $1.50 each. Discounts are allowed to libraries, publishers, and subscription agencies.



J. H. Foote

D. L. Greene

AIEE PERSONALITIES

Nominated for Institute President, 1959-60

J. H. Foote (AM '18, F '32, Member for Life), chief engineer, Commonwealth Associates, Inc., and director of engineering, Commonwealth Services, Inc., Jackson, Mich., has been nominated for the office of President of the AIEE. Mr. Foote was born in Jackson, Mich. He received a B.S. degree in C.E. at Michigan State University in 1914. His engineering experience during the next 35 years included field surveying on hydroelectric projects, transmission and distribution line design and construction, electrical engineering of power systems, and from 1936, responsibility for the Northern Division of the engineering service organization of the Commonwealth and Southern Corporation (N.Y.). In 1949, this company was purchased by its employees, and Mr. Foote became a director and vice-president of this company, Commonwealth Services, Inc., and chief engineer and head of its engineering affiliate, Commonwealth Associates, Inc. Recently, he relinquished the executive direction of Commonwealth Associates, Inc., to J. R. North, retaining the position of chief engineer and assuming the position of director of engineering in addition to his office of vice-president of Commonwealth Services, Inc. He is also a director of Atomic Power Development Associates, Inc. Mr. Foote's technical and professional society memberships include: American Society for Testing Materials, in which he served 2 years on the Executive Committee and 3 years on the Board of Directors; American Standards Association, of which he is now a member of the Board of Directors; American Society of Mechanical Engineers; National Society of Professional Engineers; American Association for the Advancement of Science; American Society for Engineering Education; and Conference Internationale des Grands Reseaux Electriques. In the State of Michigan, he is a member of the Engineering Society of Detroit, the Michigan Engineering Society (past president), the Economic Club of Detroit, and the Town Club and the Country Club of Jackson. Mr. Foote is a member of the honor fraternities Tau Beta Pi, Eta Kappa Nu, and Pi Tau Sigma. In 1958, the degree of doctor of science in engineering was conferred on him by Wayne State University. Mr. Foote served the Institute as director, 1954-56; vice-president for District No. 5, 1956-58; and is presently serving as chairman of the Administration Department. He has been a member of numerous AIEE Committees including: Power Transmission and Distribution (1929-31), Protective Devices (1932-34), Power Generation (1936-46), Domestic and Commercial Applications (1940-41), Registration of Engineers (1946-59), Standards (1947-50), Insulated Conductors (1947-49), Safety (1954-57), Planning and Co-ordination (1954-56), Edison Medal (1955-57).

Nominated for Institute Vice-Presidents

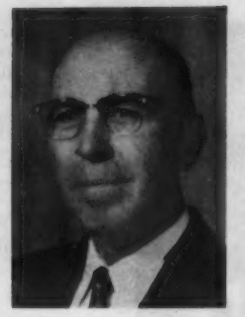
D. L. Greene (AM '40, M '47) assistant chief electrical engineer, Gilbert Associates, Inc., Reading, Pa., has been nominated for the office of AIEE Vice-President for District No. 2. Mr. Greene was born in Ellicottville, N. Y., on October 14, 1901. He joined E. L. Phillips & Co. at Penn Yan, N. Y., as chief of survey party after graduating from Tri-State College, Angola, Ind., in August 1924, and has been continuously associated with predecessor companies of Gilbert Associates, Inc. Following several months of surveying transmission and distribution lines throughout central New York State, he joined the construction department constructing substations, generating stations, etc. In 1929, he was transferred to the engineering department of the Empire Gas & Electric Co. (now NYSE&G Corp.) where he was engaged in the design of substations, transmission lines,

AIEE Lynn Section

Harry L. Levine, Photographer

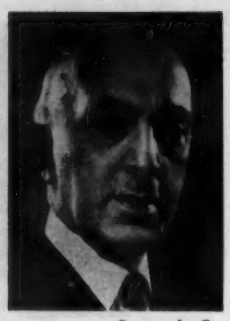
THE LYNN SECTION of the Institute is acting as sponsor of a Junior Achievement Company known as the Swinging Squares Company. Junior Achievement is a nation-wide activity designed to teach teenagers, through practical experience, how a business operates. Each company is established and operated by its youthful staff with the guidance of several adult advisors. The operations of the company include financing, accounting, product planning, product designing, manufacturing, and selling. In addition to gaining practical experience in the operations of modern business, the participants acquire a broadened viewpoint of profits, wages, and other controversial aspects of our capitalistic system. It is hoped that this will make the young people more immune to the sophistry of those who seek to discredit our economic system. In the photograph, W. W. Work, chairman, Lynn Section, presents the Junior Achievement Company charter to Miss Ellie A. Safrine, president, Swinging Squares Co. Shown (left to right) are F. R. DeSantis, advisor; Mr. Work; R. A. Dalferro, advisor; Miss Safrine; and E. F. Gibson, advisor.

J. W. Davis



M. H. Kight

G. T. Harness



Courtesy Jac Guy

Rene Dupuis

and related activity until 1937 when he was transferred to the E. M. Gilbert Engineering Co. at Reading, Pa. He continued with this company through its reorganization as Gilbert Associates, Inc., in 1942 to the present time, having been made assistant chief electrical engineer in 1950. He has been active in the affairs of the AIEE Lehigh Valley Section since 1940 having served on numerous committees as member and chairman and as chairman of the Section in 1954-55. He was active in the 1954 District No. 2 meeting; has been a member of the national AIEE Administration Department since its inception in 1956; is currently a member of the Section's Institute Affairs Committee and chairman of the Professional Development Committee; and is on the advisory committee for ASA-C57. He has three patents in the electrical field and has presented a number of papers at AIEE, American Power Conference, and Pennsylvania Electric Association meetings. Mr. Greene is a registered professional engineer in Pennsylvania and New York, has the National Certificate of Qualification, and is a member of the Pennsylvania and National Societies of Professional Engineers.

J. W. Davis (AM '33, M '55) assistant vice-president, staff operations, Southern Bell Telephone & Telegraph Co., Atlanta, Ga., has been nominated for the office of AIEE Vice-President for District No. 4. Mr. Davis, a native of Owenton, Ky., received his bachelor of science degree in physics, *cum laude*, from Georgetown College at Georgetown, Ky., in 1921. He began his telephone career that same year in Atlanta, Ga. In 1922, Mr. Davis was appointed exchange engineer in the Georgia Division, and from then until 1935 he held various positions in the engineering department, including that of division plant engineer for the State of Georgia. In 1935, he was transferred to Jackson, Miss., as division plant engineer. In 1944, he was transferred to Birmingham, Ala., as division plant engineer. In 1950, he became outside plant engineer on the company staff in Atlanta, Ga. In June 1957, he became the transmission and outside plant engineer on the east staff and on October 1, 1957, he was appointed assistant vice-president, staff operations, in charge of the Southern Bell's Engineering Program. Mr. Davis was chairman of the Alabama Section of the AIEE, 1949-50; director of the Atlanta Section, 1956-57. In November 1956, he was appointed chairman of a committee set up to present to the District Executive Committee the advantages of dividing District No. 4. The work of this Committee and the report presented in April 1957 at the Jackson Meeting lead to the inauguration of District No. 13, effective August 1, 1958. Mr. Davis is presently vice-chairman of the Joint District No. 4 and District No. 13 AIEE Meeting to be held in Atlanta, Ga., in April 1959, and vice-chairman of the Membership Committee of District No. 4 for 1958-59.

M. H. Kight (AM '37, M '49) chief, Electrical Branch, United States Bureau of Reclamation, Denver, Colo., has been nominated for the office of AIEE Vice-President for District No. 6. Mr. Kight, born in Bluff Dale, Tex., on October 26, 1900, graduated from the University of Illinois with a B.S.E.E. degree in 1923. He entered the employ of the U. S. Bureau of Reclamation at Rupert, Idaho, in 1923 as a pumping station operator and electrical assistant, and in 1924 at Denver, Colo., as a junior engineer. Mr. Kight joined the Minnesota Power and Light Company in 1926 as electrical designer of substations and transmission lines. In 1930, he returned to the U. S. Bureau of Reclamation at Denver, Colo., as engineer, and advanced through a succession of electrical engineering positions in the Assistant Commissioner and Chief Engineer's office to the present position of chief, Electrical Branch, in charge of the electrical design of power plants, switchyards, transmission lines, substations, pumping plants, and distribution lines. He has been active in the affairs of the Denver Section of AIEE, serving on various committees of the Section. Mr. Kight also served 2 years, 1946-47, and 1954-55, as secretary-treasurer; then as vice-chairman, 1955-56; and finally as chairman, 1956-57, of the Denver Section. He is a member of the AIEE System Engineering Committee (1952-59), and Systems Operations Subcommittee (1952-59). Mr. Kight is also a member of the Executive Committee of the Denver Section, a member of the Colorado Engineering Council, and has been a member of the International Conference on Large Electric Systems (CIGRE, Paris) from 1946 to the present date. He is a registered professional engineer in the State of Colorado.

G. T. Harness (AM '30, F '49), associate dean of engineering and electrical engineering professor, University of Southern California, Los Angeles, Calif., has been nominated for the office of AIEE Vice-President for District No. 8. Prof. Harness was born March 14, 1906, in Galveston, Ind. He received the B.S. degree in 1928 from California Institute of Technology, and the Ph.D. degree, *magna cum laude*, in 1933 from the same institution. His early academic career included positions at the College of the Pacific and Columbia University. He joined the faculty of the University of Southern Califoria in 1946 as professor of electrical engineering. He was named head of the department of electrical engineering in 1947 and associate dean of engineering in 1956. He has served as consultant to numerous companies since 1933. During World War II, he was consultant on educational problems for the War Department. Prof. Harness is the author of numerous papers and coauthor of a 2-volume textbook on electrical engineering. He is a member of the American Society for Engineering Education, Sigma Xi, Tau Beta Pi, Eta Kappa Nu, and Phi Kappa Phi. Prof. Harness has been active on the following AIEE Committees: Electrical Machinery (1942-47); Research (1943-47); Radio Technical Planning Board (1943-44); Rotating Machinery (1947-48); Basic Sciences (1954-56); Electronics (1955-1957); Sections (1955-58, vice-chairman west, 1958-59); Student Branches (1955-56); Administration Department (1956-57). He is listed in "Who's Who in America," "Who's Who in Engineering," and "American Men of Science."

Rene Dupuis (M '44, F '55), commissioner, Quebec Hydro-Electric Commission, Montreal, Que., Canada, has been nominated for the office of AIEE Vice-President for District No. 10. Born in the Eastern Townships, Canada, Dr. Dupuis graduated in arts from Quebec's Laval University in 1919, then attended McGill University and the University of Nancy, France, where he obtained certificates of advanced studies in mechanics and physics. He was graduated in electrical engineering from France's Electrotechnical Institute in 1924. Following practical training with the Canadian Westinghouse Co. at Hamilton, Dr. Dupuis was associated with the Shawinigan Water & Power Company, at Shawinigan Falls and

Three Rivers, and, subsequently, with Quebec Power as distribution engineer, assistant superintendent of the Power Division, and assistant general superintendent of the company and its subsidiaries. In 1942, he established and organized the School of Electrical Engineering of Laval University in Quebec. In 1947, he assumed charge of Beauharnois operations as superintending engineer for the Quebec Hydro-Electric Commission: he then became one of the five members of the Commission. He was connected very closely with such projects as the Bersimis developments, the Beauharnois expansion, and the most powerful underwater cable in the world, linking the north and south shores of the St. Lawrence River, a distance of over 30 miles. Appointed a director of Atomic Energy of Canada, Ltd., by the Canadian Government, in March 1952, Dr. Dupuis relinquished this post in March 1954, and became a member of the Canadian Section of the International St. Lawrence River Board of Control. The author of a well-known and widely consulted dictionary, "De l'Anglais au Français en Électrotechnique," Dr. Dupuis has written numerous articles and lectured to technical societies. To the title of Professor Emeritus, conferred upon him in 1947, Quebec's Laval University added an honorary doctorate in 1953. The Government of France awarded him the "Palmes Académiques" in 1948. Dr. Dupuis holds membership in the Corporation of Professional Engineers of the Province of Quebec; the Engineering Institute of Canada, the Quebec Chapter of which he served one term as chairman; the Canadian Electrical Association; the International Conference of Large Power Systems (CIGRE), of which he is an administrator; the Board of Governors of Ste. Jeanne d'Arc Hospital; and the McGill Graduate Society, of which he is a director.

F. S. Bacon, Jr. (AM '37, M '44), Winchester, Mass., has been nominated for the office of AIEE Vice-President for District No. 12. Mr. Bacon was born June 3, 1913, at Middletown, Conn. He received the B.S. degree in E.E. from Northeastern University in 1936. Upon graduation, he entered the engineering department of the Hytron Corporation in Salem, Mass. Early in 1937, he left Hytron to enter the graduate student course of the Westinghouse Electric Corporation in Pittsburgh, Pa. He was assigned to the Utility Division of the Boston office of Westinghouse in 1939 and progressed as assistant manager in 1941 and manager of New England Utility Division in 1946. In 1948, he joined Rockbestos Products Corporation, New Haven, Conn., as assistant general sales manager. In 1952, he was appointed general sales manager, Gamewell Company, in Newton Upper Falls. In 1953, he started his own sales agency in New England representing Southern States Equipment Corporation and Kuhlman Electric Company in the application and sale of their products to the utility industry. Mr. Bacon is a registered professional engineer in both Massachusetts and Connecticut. He is a member of the Massachusetts Society of Professional Engineers and was president of that organization in 1954. He was chairman of the Boston Section of AIEE in 1945. He has served on the AIEE Membership Committee (1944-49), Industrial Power Applications Committee (1944-45), and Sections Committee (1953-59). He is presently secretary of District No. 12. He is also a member of the Institute of Radio Engineers.

Nominated for Institute Directorships

Hendley Blackmon (M '32, F '49), engineering manager, association activities, Westinghouse Electric Corporation, Pittsburgh, Pa., has been nominated as a Director of the AIEE. Reared in Macon, Ga., Mr. Blackmon was graduated from the Georgia School of Technology with a B.S. degree in E.E. After completing the Westinghouse Graduate Student Course, he did development work in the switchboard engineering department. A few years later he was promoted to the general engineering department, and then to the public relations department. In 1945, he resigned to join McGraw-Hill Publishing Co. as electrical editor of *Product Engineering*, and soon was promoted to managing editor. Two years later, he was appointed managing editor of *Electrical World*. Mr. Blackmon returned to Westinghouse in 1949 to work on technical society matters. Mr. Blackmon's Institute service includes: Technical Operations Department (chairman 1957-59; vice-chairman 1956-57); Technical Operations Committee (1953-56; secretary 1954-56); Technical Program Committee (1950-52); Planning and Co-ordination Committee (1954-56, 1958-59); Board of Examiners (1954-59); Administration Department (1956-57); Safety Committee (1949-59, chairman 1951-53); EJC Committee on Honors (1955-59); alternate, John Fritz Medal Award (1955-59); District No. 2 TOD representative (1956-57); national Nominating Committee, District No. 2 (alternate 1956-57, delegate 1957-58); District No. 2 Executive Committee (1956-57); Pittsburgh Section, Executive Committee (1958-59); Pittsburgh Section, Institute Activities Committee (1957-59, chairman 1959). In related outside organizations, such as the American Standards Association (ASA), Mr. Blackmon is vice-chairman of the Electrical Standards Board and chairman of the Power Division. He also serves as member of Standards Council, Board of Review, Committee on ASA Procedure, C-42, Definitions of Electrical Terms, Safety Standards Board, and chairman of Panel I of the National Electrical Code. As a member of American Society of Mechanical Engineers, his service record includes member of Publications Committee, Public Relations Committee, Professional Divisions Committee, Safety Division, Board on Codes and Standards, and delegate to national Nominating Committee. In the National Electrical Manufacturers Association, Mr. Blackmon is chairman of Codes and Standards Committee, and chairman of the Committee on Higher Utilization Voltages and Circuits. He is a member of the Safety Regulations Committee, Policy Committee on Underwriters' Laboratories, Inc., ASA Relations Committee, and a number of other technical activities. In international activities, since 1951 Mr. Blackmon has been a member of the U. S. National Committee of the International Electrotechnical Commission, and in 1957 was elected vice-president. Since 1953, he has been chairman of the U. S. National Committee on Participation in CEE, which is the International Commission on Rules for Approval of Electrical Equipment. Mr. Blackmon also is a senior member of the Institute of Radio Engineers. He is the recipient of the Westinghouse Order of Merit, the highest honor bestowed on employees for outstanding work.

E. I. Green (AM '23, F '46, Member for Life), executive vice-president, Bell Tele-

F. S. Bacon, Jr.

The Brookner Studio

Hendley Blackmon

Fabian Bachrach

E. I. Green

Roberts Studio

S. M. Osthagen

phone Laboratories, Inc., Murray Hill, N. J., has been nominated as a Director of the AIEE. Mr. Green, received an A.B. degree from Westminster College, Fulton, Mo., in 1915 and a B.S. degree in E.E. from Harvard University in 1921. He was awarded an honorary D.Sc. by Westminster in 1956. He joined the department of development and research of the American Telephone & Telegraph Company in 1921 and transferred to the Bell Telephone Laboratories in 1934. He was appointed director of transmission apparatus development in 1948; director of military communication systems in 1953; vice-president, systems engineering, in 1955; and he assumed his present post in 1959. At different periods he has been responsible for planning the development of carrier and coaxial systems, developing transmission measuring apparatus and microwave radar testing gear, developing electronic components and parts, and planning and developing communication systems. In addition to his technical activities, Mr. Green has responsibilities in connection with education and management development in his organization, as well as with aspects of interpersonal relations. He is the author of a number of papers dealing with technical, personnel, and management subjects. Mr. Green is a Fellow of the Institute of Radio Engineers, and a member of the Acoustical Society of America and of the Operations Research Society of America. Mr. Green has served on numerous AIEE Committees including the following: Instruments and Measurements (1942-50, chairman 1947-48); Standards (1947-50); Technical Program (1947-49, 1951-52); Communication and Science Co-ordinating (1947-49); Science and Electronics Division (1950-54, chairman 1950-52); Technical Advisory (1950-52); liaison representative on Standards (1951-54); Technical Operations (1952-56); Planning and Co-ordination (1952-59); Award of Institute Prizes (1952-56, chairman 1952-54); Engineering Foundation (1955-58); Publications (1957-58); EJC representative (1957-58); Education (1958-59); Members-for-Life (1958-59).

S. M. Osthagen (AM '47, M '54), district manager in Providence, R. I., for the Allis-Chalmers Manufacturing Company, has been nominated as a Director of the AIEE. Mr. Osthagen is a graduate of Wentworth Technical Institute, Boston, Mass., with a certificate in electrical engineering. For the past 17 years, Mr. Osthagen has been associated with the Allis-Chalmers Manufacturing Company. He has been very active in many AIEE Committees including the Executive Committees of both the Boston and Providence Sections. He has served on the National Public Relations Committee for 3 years; was District secretary of District No. 1 in 1956, and vice-president of District No. 12 for 1957-59. Mr. Osthagen is a senior member of the Providence Engineering Society, and is a registered professional engineer in the State of Rhode Island and a member of the National Society of Professional Engineers.

P. L. Alger (AM '17, F '30, Member for Life), an internationally known electrical engineer whose work helped to motorize American industry, retired from the General Electric Company (GE) February 1. He is now an adjunct professor at Rensselaer Polytechnic Institute. During his 40-year career with GE, Mr. Alger has gained recognition as a contributor in widely different areas. Holder of over a dozen patents, he has helped motivate hundreds of young engineers; has worked with other engineers to develop a system of ethics in his profession, has constantly urged engineers to participate more in politics and civic affairs, and has promoted programs for better government and schools in his own state and community. His major contributions to the development of motors and generators have been in the critical areas of calculating reactance, improving starting performance, and reducing magnetic noise. Design changes Mr. Alger introduced made it possible to build smaller, lighter-weight, less costly motors—stimulating the development of modern machine tools, and the mechanization of industry. Mr. Alger has written more than 80 papers, has authored two technical books since 1950, and is currently active in 34 professional, civic, or social groups. Mr. Alger has served on numerous Institute Committees including the following: Electrical Machinery (1926-42, chairman 1929-32); Technical Program (1939-45, chairman 1941-43); Standards (1932-44); Planning and Co-ordination (1941-43, 1945-47); Award of Institute Prizes (1941-44, chairman 1941-43); Executive (1944-47); Edison Medal (1944-48); Research (1945-47); Code of Principles of Professional Conduct (1948-50, 1952-59, chairman 1955-59); Rotating Machinery (1951-59); Professional Development and Recognition (1956-57).

O. M. Bundy (AM '46, M '50), director of research, Clark Controller Company, Cleveland, Ohio will also serve as manager of the New Products Division of the company. Mr. Bundy is serving on the AIEE General Industry Applications Committee (1951-59).

Henri Busignies (M '56, F '59), president of ITT Laboratories of International Telephone & Telegraph Corporation, has been granted basic patents on four important electronic developments in the fields of long distance communication, radar, and medicine. Mr. Busignies already holds patents on more than 100 inventions in electronics and related fields.

E. B. Doll (AM '38, M '47) has been elected a vice-president of Space Technology Laboratories, Inc. (STL), Los Angeles, Calif. Dr. Doll will assume new responsibilities as director of STL's Systems Engineering Division. For the present, he will also continue to serve as program director for the USAF's Atlas, a position he has held since 1956. He served on the AIEE Electronics Committee (1955-1956).

J. H. DuBois (M '54) has been named as management and engineering consultant for Tech-Art Plastics Company.

W. C. Dunlap (M '51), supervisor of solid-state research at the Bendix Aviation research laboratory, Detroit, Mich., has been named director of semiconductor research for the Research Division of Raytheon Manufacturing Company. He served on the AIEE Basic Sciences Committee (1951-59, chairman 1957-59), and Science and Electronics Division (1957-59).

F. P. Fairchild (M '55), chief engineer in the electric engineering department, Public Service Electric and Gas Company, Newark, N. J., retired January 28. In July 1936, Mr. Fairchild became associated with Public Service as a mechanical engineer, and, a year later, was made chief engineer of the company. He was recently presented the American Society of Mechanical Engineers George Westinghouse Gold Medal Award for ". . . eminent achievement and distinguished service in the power field of mechanical engineering." Mr. Fairchild has been succeeded by **R. A. Baker** (M '56), who was formerly assistant chief engineer.

A. W. Gelbke (AM '30, M '54), electrical engineer, Ebasco International Corporation, Mexico City, Mexico, has been named vice-president and general manager of Industrial Electrical Mexicana, S. A., Mexicali, Baja California, Mexco. Mr. Gelbke has been a member of the AIEE Sections Committee (1956-59).

A. F. Jones (AM '44, M '48), executive engineer at ITT Laboratories, Nutley, N. J., has been promoted to chief engineer of the Cuban Telephone Company, Havana, Cuba, an operating company of the International Telephone and Telegraph Corporation. He is a member of the AIEE Communication Switching Systems Committee (1956-59).

J. F. Kalbach (AM '37, M '44), field engineering manager for Burroughs Corporation's ElectroData Division, has been appointed associate director of engineering. He is a member of the AIEE Computing Devices Committee (1957-59). Simultaneously, **R. W. Anderson** (AM '46) was named manager of quality assurance.

S. C. Killian (AM '42, F '58) has been appointed vice-president and general manager of the Delta-Star Electric Division, H. K. Porter Company, Inc. Mr. Killian has served on the Delta-Star executive staff for 6 years, most recently as vice-president and assistant general manager. He is a member of the AIEE Substations Committee (1948-59).

Frederick Krug (AM '17, F '36), president of the Canadian International Power Company, Montreal, Que., Canada, has been awarded the 1959 Gano Dunn Medal for Professional Achievement by the Cooper Union Alumni Association. Mr. King is active in the Engineers' Clubs of Montreal and New York, the International Chamber of Commerce, the Montreal Board of Trade, the Venezuelan Chamber of Commerce of the United States, the Canadian–American Society, the Pan

American Society, and many other international organizations. He served on the AIEE Membership Committee (1943-45) and Sections (1943-46).

C. G. Lloyd (M '55), general manager of the specialty electronic components department, General Electric Company (GE), Auburn, N. Y., has been named general manager of the newly established rectifier product section of GE's semiconductor products department. He served on the AIEE Television and Aural Broadcasting Systems Committee (1955-57).

A. L. Malmstrom (M '48), transmission engineer for Detroit Edison Company, has retired after 37 years of service with the company. A registered professional engineer, he is a member of the Engineering Society of Detroit and has served on committees for the Edison Electric Institute. He is a member of the AIEE Transmission and Distribution Committee (1954-59).

Bazil Nikiforoff (AM '17, F '46, Member for Life) has retired as technical director of the Mexican Light and Power Company after 34 years of service. Mr. Nikiforoff joined the company in 1925 as chief electrical engineer and was promoted in 1950 to the post of technical director. Mr. Nikiforoff is a past president of the Mexico Section of the AIEE. He served on the AIEE Sections Committee (1949-52).

G. B. Rathbun (AM '48), motor project manager, has been named engineering manager for electrical products at Westinghouse Electric Corporation's Sunnyvale, Calif., division. Mr. Rathbun succeeds **J. H. Cox** (AM '24, F '57), who has retired. Born in Newman Grove, Nebr., Mr. Cox was graduated from the Massachusetts Institute of Technology and joined Westinghouse in 1923 as a service engineer in New York City. During World War II, he helped to engineer vital vacuum and leak detecting apparatus for the atomic bomb project. Earlier, he pioneered in the field of lighting research and mercury arc rectifier engineering. He was responsible for the development and design of the Ignitron rectifier. Mr. Cox has served on several AIEE committees including: Electrical Machinery (1938-43), Electronics (1942-45), Electronic Power Converters (1947-50), Domestic and Commercial Applications (1957-59), and Professional Conduct (1958-59).

D. C. Sherrick (M '56) has been appointed managing director of Smith-Corona Marchant's Highland Park (Ill.) Laboratories. Previously, he was research supervisor of the Research and Development Division. He is a member of the AIEE Telegraph Systems Committee (1958-59).

R. M. Shoop (AM '45), associate editor, *Electrical World*, McGraw-Hill Publishing Co., New York, N.Y., retired March 1. He had been associated with McGraw-Hill since 1936.

F. M. Tait (AM '94, F '12, Member for Life), honorary chairman, Dayton Power and Light Company, was recently honored for service to his community. At a ceremony sponsored by the Dayton Area Chamber of Commerce, Mr. Tait received a plaque reading "The Dean of American Industry for the years dedicated to the service of the Dayton area and for his vision and accomplishment in the success of Dayton Power and Light, the Tait Manufacturing Company and the Tait Foundation. This recognition is tendered from his community."

R. D. Teasdale (AM '46, M '54), has been named assistant head of the systems analysis department of Hughes Aircraft Company's Ground Systems Group. Dr. Teasdale joined Hughes from Melpar, Inc., of Falls Church, Va., where he had been staff assistant to the chief engineer.

M. C. Titus (AM '39) has been elected president and manager and a member of the board of directors of Cia. Anonima Luz Electrica de Venezuela, operating electric affiliate of American & Foreign Power Company Inc., in Venezuela. Mr. Titus relinquished his duties as assistant to the president of American & Foreign Power Company. He continues as vice-president of American & Foreign Power.

E. U. Thomas (AM '36, M '45) has joined the Railroad Products Division, Servo Corporation of America, New Hyde Park, N. Y., as development engineer. He was formerly with Union Switch & Signal Company.

J. M. Webb (AM '35, M '53) has been promoted to the position of director of the Engineering Maintenance Division, Eli Lilly and Company, Indianapolis, Ind. He had been assistant division director of the Engineering Division. Mr. Webb is past chairman of the Central Indiana Section of the AIEE. He served on the AIEE Industrial Power Applications Committee (1944-46).

Jackson & Moreland, Inc., has announced the following executive promotions. Effective January 1, 1959: **F. M. Carhart** (M '24, F '32, Member for Life), chairman of the board and chairman of the Finance Committee; **R. D. Booth** (AM '24, F '53), president; **Hartley Rowe** (AM '08, F '48, Member for Life), assistant to the president and member, board of directors. Effective August 1, 1958: **J. R. Coffin** (AM '24, M '31), senior vice-president; **R. E. Cairns** (AM '41), vice president and treasurer; **H. W. Hills** (AM '25, F '51), vice-president; **A. Y. Taylor** (AM '37, M '40), vice-president.

H. J. Huber (AM '50), member of the technical staff, Ramo-Wooldridge Corporation, has been appointed section manager, Government and Industrial staff, Research Division, Philco Corporation, Philadelphia, Pa.

C. A. Novy (AM '57) of Motorola, Inc., has been appointed assistant to the chief engineer of applied research for Motorola's Communications & Industrial Electronics Division.

The Institute of Radio Engineers (IRE) board of directors has announced the following appointments. Reappointed as treasurer of the IRE was **W. R. G. Baker** (AM '19, F '47, Member for Life), vice-president for research of Syracuse University, Syracuse, N. Y. **Haraden Pratt** (AM '15, F '37), vice-president of Dualex Corp., New York, N. Y. was appointed to his 17th term as IRE secretary. **J. D. Ryder** (AM '40, F '51), dean of engineering, Michigan State University, East Lansing, Mich., was appointed editor of the IRE for the second year. Appointed as directors were **L. V. Berkner** (AM '29, F '47), president of Associated University, Inc., New York, N. Y.; **A. N. Goldsmith** (M '15, F '20, Member for Life), consulting engineer, New York, N.Y., and editor emeritus of the IRE; and **G. K. Teal,** assistant vice-president and director of Research, Texas Instruments, Inc., Dallas, Tex.

W. R. Brownlee (AM '35, F '51), of Southern Services, Inc., Birmingham, Ala., has been appointed power pool manager, responsible for co-ordinating the power supply operations of the Alabama, Georgia, Gulf, and Mississippi Power Companies and the Southern Electric Generating Company of the Southern Company system. Mr. Brownlee is a director of the AIEE (1956-60) and has served on numerous committees including the following: Protective Devices (1937-42, 1946-47); Relays (chairman 1947-49); Standards (1947-49, 1952-59); Technical Program (1947-49, 1950-51); Power Division (1947-55, chairman 1951-53, 1956-59); System Engineering (1949-52); Award of Institute Prizes (1950-52, 1954-59, chairman 1954-56); Technical Operations (1952-56); Planning and Coordination (1953-54, 1955-56); Professional Development and Recognition (1956-59); Edison Medal (1956-60); Recognition Awards (chairman 1957-59).

F. G. Hamner (AM '31, M '53) has been named system planning engineer for Southern Services, Inc. **N. F. Williams** (AM '53) retains his position as assistant to the president and will also act in the capacity of consultant on foundation problems and hydro projects. **O. E. Charlton** (AM '26 F '56) will become system electrical engineer and will co-ordinate the work of the system planning section. Mr. Charlton served on the AIEE Protective Devices Committee (1940-47) and System Engineering Committee (1949-58).

E. D. Early (AM '46, M '53) has been elected vice-president in charge of operating services of Southern Services, Inc., with responsibility for power pool, rate, and system planning activities of the company for the Alabama, Georgia, Gulf, and Mississippi Power Companies and the Southern Electric Generating Company of the Southern Company system.

OBITUARIES

Thomas Hampton Allen (M '37, F '44), president, Memphis Light, Gas & Water Division, died recently at the age of 77. Mr. Allen was born in St. Louis, Mo., on October 27, 1881. He graduated from the University of Tennessee in 1903 with a degree in science and mechanical engineering, after which he joined the Allis

Chalmers Manufacturing Company in Milwaukee. In 1908, he returned to Memphis, where he set up the firm of Allen & Hoshall, consulting engineers. During World War I, he served as a Corps of Engineers officer. He became president of the Memphis Light, Gas & Water Division in 1940. Among the honors accorded Mr. Allen were the presidency of the American Public Power Association in 1948, recognition as "Engineer of the Year" in 1955 by the Tennessee Society of Professional Engineers, and the conferring of an honorary doctorate by Southwestern University in 1950. He was active in politics throughout his career, serving as a member of the Memphis City Commission from 1920 to 1928.

Ellis Laurimore Phillips (M '26, Member for Life), president, E. L. Phillips & Co., engineers, New York, N. Y., died recently. He was 85 years old. Mr. Phillips was founder and former president of the Long Island Lighting Company. Born near Naples, N.Y., he received mechanical and electrical engineering degrees from Cornell in 1895. In that same year, he started his career as an engineer for Westinghouse, Church & Kerr. He was president of Long Island Lighting from 1912 to 1937, and chairman from 1937 until 1945. Mr. Phillips donated the electrical engineering building known as Phillips Hall to Cornell University, Ithaca, N. Y. He was a member of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers.

Thomas W. Rochester (AM '06, M '16, Member for Life), consulting engineer, Corning, N. Y., died recently at the age of 66. Mr. Rochester was an electrical engineering graduate of Columbia University's School of Engineering. He also attended Cooper Union and New York University. In 1929, he was appointed chief engineer of the New York City Police Department, and served in this position until 1942, when he became a consulting engineer. Mr. Rochester was an authority on police radio and traffic-control systems.

William E. Lawton (AM '38, M '54), northwest power manager for the Aluminum Company of America (ALCOA), Vancouver, Wash., died recently. Mr. Lawton was born in Rice Lake, Wis., on July 21, 1917. Following his graduation from the University of Washington, Seattle, in 1940, he joined ALCOA in Vancouver. In 1951, he was transferred to the company's Wenatchee, Wash., plant as chief electrical engineer. Two years later, he was transferred to their Pittsburgh, Pa., staff and there became staff electrical engineer. Mr. Lawton returned to ALCOA's Vancouver plant in 1954 as chief electrical engineer and in 1958 he was promoted to northwest power manager. He was a registered professional engineer. Mr. Lawton served on the AIEE Industrial Control Committee (1951-54).

Joseph G. Tarboux (AM '21, M '32, F '43, Member for Life), professor of electrical engineering at The University of Michigan (U-M), died recently. Born in Brazil of missionary parents, Prof. Tarboux received his B.S. degree in 1918 from Clemson College; and an electrical engineering degree in 1923, a master's degree in 1926, and a doctor of philosophy degree in 1937, all from Cornell University. While at U-M, Prof. Tarboux carried the primary responsibility for undergraduate and graduate instruction in electric power engineering. He was a consultant to the Detroit Edison Company where he taught a number of courses to employees. Also, through the University's Extension Service, he was teaching a similar type of course to employees of the Consumers Power Co., Jackson, Mich. He was active as a counselor to students and was national vice-president of Eta Kappa Nu, national engineering honor society. Prof. Tarboux was a member of the American Society for Engineering Education, Institute of Radio Engineers, National Society of Professional Engineers, Engineering Society of Detroit, Tau Beta Pi, Phi Kappa Phi, and Sigma Xi. He had been active on AIEE Committees, including the following: Membership (1941-43); Education (1943-49, chairman 1946-48); Standards (1946-47); Technical Program (1946-48, 1951-52); Hoover Medal Board of Award (1947-53); Science and Electronics Division (1950-52); Board of Directors (1950-52); Student Branches (1951-52); System Engineering (1954-58). He had served as vice-president of District No. 1, 1950-52.

Edward Claud Curtis (AM '21, M '26, Member for Life), retired, of Albuquerque, N. Mex., died recently. Mr. Curtis was born June 27, 1886. He attended the University of Colorado where he received the B.S. degree in E.E. in 1907. He was employed by several firms during his engineering career, including the General Electric Company, Electric Bond & Share Company, Kansas Gas & Electric Company, and Compania Cubana de Electricidad, Inc., of Havana, Cuba.

Charles J. Daly (AM '21, M '30, F '46, Member for Life), transmission and protection engineer, Southern New England Telephone Co., New Haven, Conn., died recently. Mr. Daly was born March 28, 1887 in New Haven. In 1909, he received a bachelor of philosophy degree from the Sheffield Scientific School of Yale University. He joined the Southern New England Telephone Co. in 1911.

Charles Arthur Howlett (AM '46, M '55), insulation engineer, ballast department, General Electric Company, Danville, Ill., died recently. Mr. Howlett was born February 3, 1920, in Valparaiso, Ind. He received the B.S. degree in E.E. in 1941 from Rose Polytechnic Institute. Following graduation, he joined the General Electric Company in Schenectady, N.Y., as a test engineer. He was a registered professional engineer in the State of Indiana.

John Henry Klinck (AM '95, M '07, F '13, Life Member), retired, of Tampa, Fla., died recently at the age of 86. Mr. Klinck was born September 13, 1872, in Charleston, S.C. He received the M.E. degree in E.E. from Cornell University in 1894, and the M.S. degree from Lehigh University in 1899. After graduating from Lehigh, he joined the Forman Stone Supply Company. He was employed for a few years by the Lehigh Valley Railroad, after which, in 1904, he joined Westinghouse at East Pittsburgh, Pa. Mr. Klinck was a member of the American Society of Mechanical Engineers and the American Society of Civil Engineers.

Malcolm Robertson McKinley (AM '53), vice-president, Tampa Electric Company, Tampa, Fla., died recently. Mr. McKinley was born July 23, 1897, in Lowell, Mass. He received the S.B. degree from the Massachusetts Institute of Technology. In 1928, he joined the Tampa Electric Company as general superintendent, and in 1946, was named vice-president.

Martin G. Nichols (AM '51) of C. F. Braun & Co., died recently. Mr. Nichols was born March 1, 1902, in Pennsylvania. His engineering career included employment with several firms including San Joaquin Light & Power Company, Southern California Edison Company, Pacific Western Oil Corp,. and M. W. Kellogg Co. He joined C. F. Braun & Co., in 1947.

Percival Herbert Powell (AM '06, M '15, Member for Life), retired, Christchurch, New Zealand, died recently. Mr. Powell was born July 13, 1882, in Liverpool. He received the B.Sc. degree from the University of Liverpool in 1901; and the M.Sc. from Victoria University and M.Eng. from Liverpool both in 1904. In 1905, he was appointed to Canterbury College, University of New Zealand, at Christchurch, as a lecturer in electrical engineering.

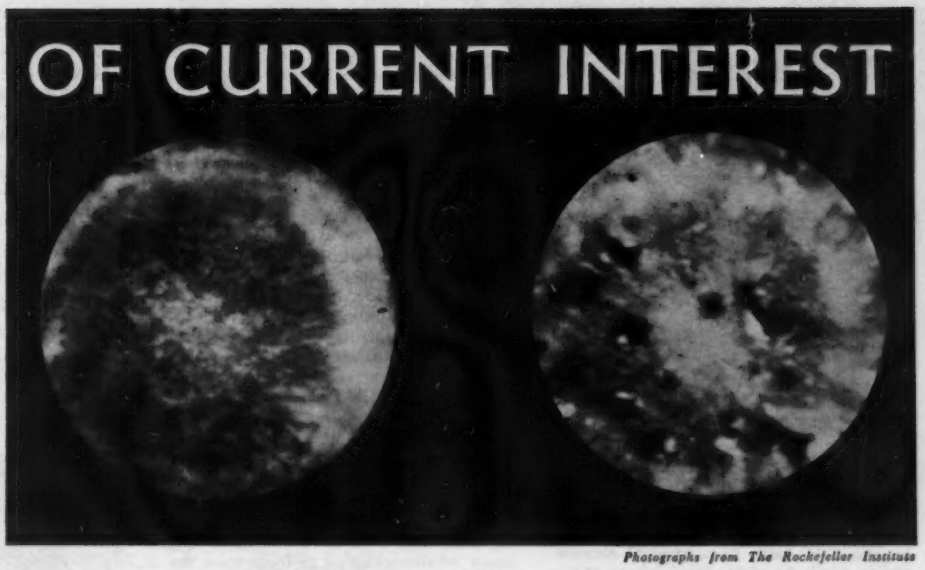
Victor L. Sansted (M '56), consultant, American Gas & Electric Service Corp., New York, N.Y., died recently. Mr. Sansted was born Novemeber 27, 1898, in New York, N.Y. He attended the City College of New York and was a registered professional engineer. He was employed by several firms during his career, including Otis Elevator Co., General Motors Co., Brooklyn Edison Co., New York Edison Co., and Stevens & Wood. He joined the American Gas & Electric Service Corp. in 1922.

James Kay Smith (AM '48), assistant engineer, engineering section of the electric transmission and distribution department, Iowa-Illinois Gas & Electric Company, Davenport, Iowa, died recently. Mr. Smith was born January 23, 1925, in Sioux City, Iowa. He received the B.S. degree in E.E. from Iowa State College, Ames, in 1947. He had been employed by Iowa—Illinois Gas & Electric Company since 1948.

Max Albert Whiting (AM '07, Member for Life), retired, Centerville, Mass., died recently at the age of 74. Before retirement, he had been employed by the General Electric Company at Schenectady, N. Y. Mr. Whiting was born August 1, 1884, in Watertown, Wis. He graduated in electrical engineering from the University of Wisconsin, Madison, in June 1904, with the B.S. degree. He joined the General Electric Company in 1905.

Wear Your ◆ AIEE Badge

OF CURRENT INTEREST



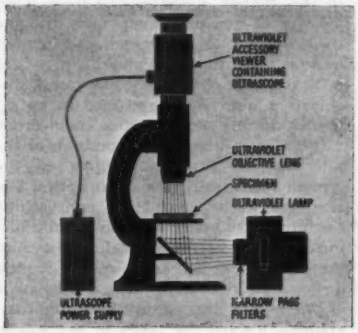
INVISIBLE details of brain cell are displayed. Photomicrograph on left shows an unstained section of human brain as seen in visible white light. Almost no cell structure is visible. Identical specimen (on the right) is viewed in the ultraviolet which has been converted to visible light with the aid of ultrascope tube. The irregular black spots are nerve cells (pyramidal neurons). Gray matrix can now be seen to have a number of clear spaces.

Photographs from The Rockefeller Institute

Ultrascope Electron Tube
Aid to Medical and Industrial Research

ULTRASCOPE, a new electron tube that is expected to be exceptionally helpful in medical and industrial research was demonstrated recently in New York City at a special showing.

The tube is the "eye" of a new simple attachment for a microscope, which for the first time allows direct visual focusing of an image under ultraviolet light. It converts invisible ultraviolet images of specimens into visible pictures that can be interpreted quickly by medical research workers. Replacing the regular eyepiece of a microscope adapted for ultraviolet viewing, the Radio Corporation of America (RCA) device is hailed as a significant step along the road of co-operation between medicine and electronics.



ULTRAVIOLET microscope with ultrascope accessory. This microscope is the first instrument of its kind which allows direct visual focusing of an image while under ultraviolet light.

Availability

A commercial model of the ultraviolet image-converted unit, equipped for direct viewing and photography, will be made available in the near future by Bausch & Lomb Optical Company, of Rochester, N. Y.

Representatives of the press, the medical profession, and microscope manufacturers saw demonstrations of the new device, which was designed by R. G. Stoudenheimer of the Photo and Image Tube Engineering activity at the RCA Electron Tube Division plant, Lancaster, Pa. During the demonstration, J. L. Burns, RCA president, presented a prototype of the microscope attachment to Dr. J. R. Heller, director, National Cancer Institute.

This new microscope accessory is expected to be a valuable asset in hospitals, medical schools, and biochemical manufacturing, said D. Y. Smith, vice-president and general manager, RCA Electron Tube Division. It should also find application in many areas of industrial research for ultraviolet examination of organic materals, including latex, nylon, tobacco, paint, and foods, he said.

Cylindrical in shape, the new tube is 2¼ inches long and 1⅝ inches in diameter.

"All methods of ultraviolet microscopy take advantage of the fact that specimens absorb ultraviolet rays in various degrees depending on the ultraviolet wavelength," Mr. Smith explained.

"Evaluation tests of a prototype of this accessory at the National Institutes of Health reveal that this new device has a very satisfactory degree of resolution—the ability to reproduce detail in small areas of a specimen."

The Institutes of Health tests were conducted under the supervision of Dr. G. Z. Williams, chief of clinical pathology and a recognized authority on ultraviolet microscopy. The tests have produced "promising results," Mr. Smith said.

Many Uses

"Use of the accessory with the ultrascope has several important advantages over previous ultraviolet microscopy techniques," he pointed out. "For the first time it offers a simple electronic tool for ultra-

ULTRASCOPE TUBE and a 35-mm camera for photo records are features of the new Bausch & Lomb U-V Photo-Microscope. The various parts of the instrument and its accessories are identified in simplified illustration above.

MEDICAL and industrial research are aided by new electron tube (RCA-7404), which is the "eye" of a simple microscope attachment developed by Radio Corporation of America (RCA). Called the "ultrascope," it converts invisible ultraviolet images of human tissues into visible pictures that can be interpreted by medical research workers immediately.

violet studies in medical and biological research.

"We have been informed that this device will be useful in fundamental studies of cells, the key units of living matter. These studies are essential to the increase of knowledge concerning such diseases as cancer, arteriosclerosis and viral infections."

Mr. Smith explained that the ultraviolet image-converter tube, which is the "eye" of the device, is the outgrowth of a quarter-century of RCA research and development on image tubes. RCA image-converter tubes, sensitive to infrared rays, were used in the famous "Sniperscope" of World War II and the Korean War. Mounted on gun sights, this device enabled soldiers to see enemy troops and vehicles in total darkness. Until recently, the development and production of image-converter tubes by RCA had been confined to military purposes and was handled in conjunction with the Engineer Research and Development Laboratories, Corps of Engineers, U. S. Army, at Fort Belvoir.

Working Details

Describing the new microscope accessory and how it works, Mr. Smith said:

"The ultraviolet accessory viewer consists of two units. One unit, which fits onto the barrel of a microscope, contains the ultrascope and an eyepiece; the other unit is a compact power supply. A cable connects the power supply to the ultrascope tube.

"Invisible rays from an ultraviolet lamp are projected through the specimen under observation, and through an ultraviolet objective lens. An invisible ultraviolet image of the specimen is formed on the faceplate of the image-converter tube. The faceplate transmits ultraviolet rays and has on its inner surface a photosensitive material which converts the ultraviolet image into a corresponding pattern of electrons. This electron pattern is, in turn, focused on the fluorescent viewing screen at the opposite end of the tube. Twelve thousand volts are supplied to the tube.

"A visible image of the specimen appears on the viewing screen in yellow-green light and is observed through a lens of the desired magnification. Because the human eye is most sensitive to yellow-green light, that color range provides comfortable viewing during prolonged observations."

The unit is also easily adapted to photomicrography and, thus, can provide film records of the specimen under study.

Studio "Airports" Train Pilots in Visual Take-offs and Landings

A COMPACT, realistic and economical closed-circuit television system, for the practice of one of the most vital phases of flight—the making of visual take-offs and landings—was demonstrated recently by the Curtiss-Wright Corporation at its Electronics Division, Carlstadt, N. J.

Key to this advance, announced recently by J. R. Pascuzzo, general manager Electronics Division, is a new electronic flight VISULATOR which provides a "pilot's eye" view of any airport in the world. The VISULATOR is the trade name for the company's new device to simulate visual flight.

When an aircraft breaks out of the overcast, its pilot sees the airport and surrounding terrain. So it is with visulation, or simulated vision—the pilot now sees in true perspective his entire airport as well as the runway upon which he is about to land. Thus, the gap between present day simulation and real life is virtually closed.

The major advance in the VISULATOR is the unique manner in which high fidelity closed circuit television is utilized to permit unprogrammed visual landings after instrument flight rule (IFR) approaches.

No matter how accurately a pilot flies in instrument approach, safety dictates that at some point the pilot must be able to see—to land the aircraft by visual reference to the ground. Never before has it been possible for pilots to practice on the ground this exacting transition procedure.

A panoramic television screen directly in front of the flight simulator supplies all the answers. Thus, a pilot can become familiar with any airport and its surrounding terrain—in advance of actual flight to the terminal.

The miniature models, exact replicas of enroute and destination airports are readily interchangeable. Thus, simulated take-off might originate at New York's International airport, and fly instruments all the way to Chicago until cleared to enter the local traffic pattern at Midway airport. Upon breaking out at some predetermined ceiling, the pilot "sees" Midway.

Nothing is preset. The terrain, buildings, runways—everything—appear in relation to the precise altitude and flight path being followed by the simulator. The panoramic view changes to correspond with every movement of the simulator, just as the scene changes through the windshield of a moving plane. As the final approach is made, the television camera automatically adjusts itself to angle, perspective, and focus until the wheels strike the runway.

HEART of remarkable Curtiss-Wright Visulator is its specifically designed optical system. Tip of television camera lens is compared with average "wind" match. This unique and complex lens system is teamed with f/0.97 refractive projection lens for simulator.

The simulator-visulator combination, of course, also responds to all the malfunctions and weather bedevilments which instructors faithfully cause to be simulated in the interest of sharpening pilot skills.

Years of research went into bringing the VISULATOR to its present state of perfection. More than design principles have gone into the optical systems—rather, engineering research has resulted in an extension to the art of optics engineering.

In order to simulate the position of the pilot in the airplane standing on the ground realistically, the small optical system had to be capable of approaching the miniature relief map to within 0.05 inch. Moreover, the optical qualities of the lens system had to be of the highest degree and resolution with a 90° angle of view and no perceptible brightness gradient toward the edges of the image. The lens system had to be color-corrected, and focusable to a close-up distance of from 0.25 inches to 20 feet. Since moving of the orthicon tube is not practical, this servo-controlled focusing movement had to be performed by moving the optical elements alone.

The requirement of keeping the 90° of view necessitated special arrangement of the movements. The final solution of this problem required one axis of rotation to be inclined at an angle of 45°.

While the two of the three required rotational motions, namely azimuth and roll, are simulated by rotational movements about one axis of the entire instrument, the third movement, (elevation or pitch) is being produced by combining partial rotation of corresponding optical elements about the azimuth axis and about the 45° axis.

The optical system, as designed by Perkin-Elmer, consists of 19 glass elements (more exactly—of 13 lens elements, 5 prisms, and 1 plane parallel glass plate). The 5 small pick-up lenses project an image of the three dimensional map, which in turn is being picked up by a projection system capable of projecting and focusing the final image onto the orthicon tube.

An interesting mechanical feature was designed to provide free rotational movements about the optical axis of the lens elements independent of the axial movement necessary for focusing.

Among the technical problems solved were:

1. Development of a periscopic television lens by the Perkin-Elmer Corporation in conjunction with Electronics Division engineers which had to be of such miniature physical dimensions as to permit the use of very small three-dimensional models. A model which measures only 12 by 8 feet covers a total area of over 10 square miles.

2. Presentation of a panoramic view on a screen 15 by 26 feet which in brightness and contrast, compares favorably with the better motion picture projection systems. This required the development of a high-speed, f/0.97, wide-angle refractive-type projection lens.

VISULATOR operation, in three-part artist's conception of Curtiss-Wright simulator, shows closed-circuit television camera *(upper right)* taking directions from pilots' aircraft controls. Picking up view of designated airport and surrounding terrain, camera automatically adjusts focus and perspective according to simulated altitude. Studio *(upper left)*, comprising camera and three-dimensional airport model, requires 25- by 15- by 14-foot area. Signals to camera are transmitted to projector atop cabin. Runway and airport view available from simulator cockpit can be seen in insert *(lower left)*.

First production model of the VISULATOR is to be delivered to the Federal Aviation Agency (FAA). It will be used to familiarize the FAA staff with the Boeing *707* transports flight characteristics, handling characteristics, as well as crew training requirements.

The VISULATOR with its panoramic non-programmed view, was designed as an integral part of an over-all flight training program.

Visulation, when added to all the other elements of modern Curtiss-Wright Dehmel Electronic Flight Simulator, provides sight—the most important human sense.

Tandem Electrostatic Accelerators Increase Ion Beam Energy for Nuclear Research

A DESIGN refinement in particle accelerators whereby the ion beam energy can be stepped up as much as four times to increase the utility of such machines in basic nuclear research was described recently by Dr. R. J. Van de Graaff, Massachusetts Institute of Technology.

Dr. Van de Graaff, who developed the particle accelerator bearing his name, points to the 2-, 3-, and 4-stage tandem accelerator as the most feasible source of particle energies required for effective bombardment of the heaviest of the atomic nuclei. Already in existence is the 10-mev

Future Meetings of Other Societies

AIME, 5th Annual Joint Meeting, Rocky Mt Petr Sections, Apr 2-3, Casper, Wyo. AIME, 29 W 39 St, New York 18, N. Y.

The Refrigeration Research Foundation, Meeting, Apr 2-5, Statler and Mayflower Hotels, Washington, D. C.

EEI, Annual Convention, Apr 5-9, New Orleans, La. EEI, 750 5th Ave, New York, N. Y.

Air Force Office of Scientific Research
3rd Annual Astronautics Symposium, Apr 6-8, Sheraton Park Hotel, Washington, D. C. AFOSR, ARDC, USAF, Washington 25, D. C.
International Conference on Fracture, Apr 12-16, MIT, Cambridge, Mass, and Endicot House, Dedham, Mass. AFOSR, same.

BRI, 8th Annual Meeting, Apr 6-8, Penn-Sheraton Hotel, Pittsburgh, Pa. BRI, NAS, 2101 Constitution Ave, Washington 25, D. C.

S.A.M.E., 5th National Military–Industrial Conference, Apr 6-8, Palmer Hse, Chicago, Ill. D. A. Sullivan, 140 S Dearborn St, Chicago 3, Ill.

P.E.A. Spring Meeting, Meter Comm, Apr 9-10, George Washington Motor Lodge, King of Prussia, Pa. J. W. Althouse, Jr, Phila Elec Co, 2301 Market St, Philadelphia 3, Pa.

National Library Week, Apr 12-18.

ASME
Hydraulic Div Conference, Apr 13-15, U of Mich, Ann Arbor, Mich. L. S. Dennegar, ASME, 29 W 39 St, New York 18, N.Y.
Metals Engineering Div Conference, Apr 29–May 3, Sheraton-Ten-Eyck Hotel, Albany, N. Y. ASME, same.

12th Annual Conference for Protective Relay Engineers, Apr 13-15, Elec Engg Dept, A & M Coll of Tex, College Station, Tex. L. M. Haupt, Tex A & M Res Found, Coll Sta, Tex.

Westinghouse Machine Tool Forum, Apr 14-15, Hotel Statler, Buffalo, N.Y. N. H. Gwyn, Westinghouse, 3 Gateway Center, PO Box 2278, Pittsburgh 30, Pa.

Institute of Radio Engineers, Inc.
4th Conference on Industrial Instrumentation & Control, joint ARF, Apr 14-15, IIT, Chicago, Ill. E. A. Roberts, Armour Tech Center, Chicago 16, Ill.
Southwestern Regional Conference, Apr 16-18, Dallas Memorial Aud & Baker Hotel, Dallas, Tex. J. M. Weldon, Continental Electronics Mfg Co, 4212 S Buckner Blvd, Dallas 27, Tex.
13th Annual Technical Conference on TV & Transistors, Apr 21-22, Cincinnati, Ohio. IRE, 1 E 79 St, New York 21, N.Y.

ASTE, Annual Meeting, Apr 18-22, Schroeder Hotel, Milwaukee, Wis. H. E. Conrad, ASTE, 10700 Puritan Ave, Detroit 38, Mich.

Conference for Protective Relay Engineers, Apr 30–May 1, IIT, Chicago, Ill.

Association for Computing Machinery, 14th Annual Meeting, Sep 1-3, MIT, Cambridge, Mass. *Abstracts & summary deadline:* May 4. Send to J. H. Wegstein, ACM Program Committee, NBS, Washington 25, D. C.

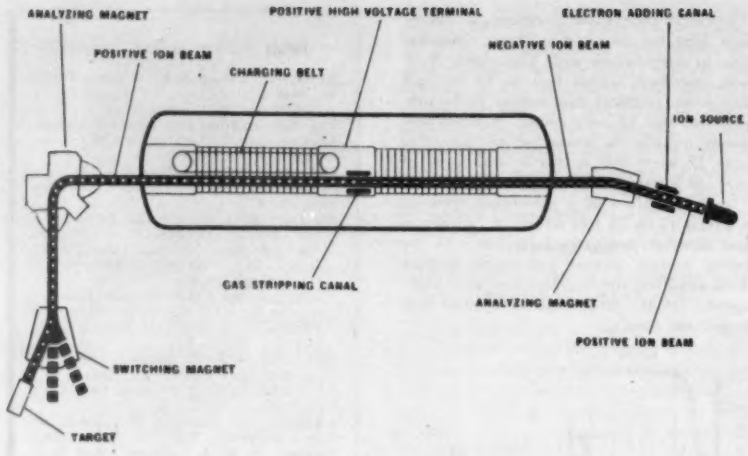
Overseas

1959 International Plastics Exhibition, June 17-27, Olympia, London, England. Derek Page, Dorset House, Stamford St, London SE 1, England.

The Institution of Electrical Engineers
Convention on Thermonuclear Processes, Apr 29-30, London, England.
International Convention on Transistors & Associated Semiconductor Devices, May 25-29, Earls Court, London, England.

4th International Congress on Electroheat, May 25-31, Stresa, Italy. M. Descarsin, Union International d'Electrothermie, 14, rue de Staël, Paris 15, France.

International Conference on Information Processing, June 15-20, UNESCO, Paris, France. Dr. S. Alexander, US Committee for ICIP, Box 4999, Washington 8, D. C.



2-Stage Tandem Accelerator

(million-electron-volts) 2-stage tandem Van de Graaff, manufactured by High Voltage Engineering Corporation, Burlington, Mass., which enables exploration of the nuclear energy level of certain heavy elements not previously possible. The tandem comprises two 5-mev Van de Graaff accelerators horizontally placed end to end with a common high-voltage terminal. With the tandem principle, it is possible to apply constant voltage to the beam not once, but two, three, or even four times, correspondingly increasing the positive-ion output energy, while retaining the precision and flexibility associated with constant-voltage acceleration.

Principles of Operation

In the case of the usual type of electrostatic accelerator, positive ions are produced inside the high-voltage terminal and then accelerated to ground in one stage of acceleration. In the case of a 2-stage tandem accelerator, negative ions are produced at ground and then accelerated to a high-voltage positive terminal. Within the terminal, the swiftly moving negative ions are stripped of electrons, thus becoming positive ions, which then receive an additional acceleration from the terminal to ground. Since the particle beam receives two stages of acceleration instead of one, the device may be called a 2-stage tandem accelerator.

The principles of operation of the 2-stage tandem accelerator may be seen in more detail from the diagram. The positive-ion beam from the ion source at the right passes into the electron adding canal. A flow of hydrogen in this canal causes the successive attachment of two electrons to some of the positive ions, thus tranforming these into negative ions. The negative-ion beam is then deflected slightly by an analyzing magnet, so that negative ions of the correct mass and energy are caused to proceed along the axis of the main vacuum tubes, and thus to be accelerated to the terminal which is at a high positive voltage. There the negative-ion beam passes into a second canal, where the presence of gas causes it to be stripped of its electrons, so that it emerges as a positive-ion beam and is then given its second acceleration which brings it back to ground. The positive-ion beam is then deflected through a 90° analyzing magnet before proceeding through a switching magnet, where it can be directed to any one of three targets. A 2-stage tandem accelerator has been constructed by the High Voltage Engineering Corporation for the Chalk River Laboratory of the Atomic Energy of Canada Limited.

Design Features

An important feature of the tandem design is that the ion source and initial accelerating and focusing arrangements are situated outside the pressure tank, rather than inside the terminal and tank, as in the usual type of electrostatic accelerator. This external location will greatly facilitate the future development of improved ion sources and injection. It also affords ample space and accessibility for the possible introduction of various new injection devices such as multiple-ion sources, apparatus for the polarization of particle beams, and equipment for beam pulsing. It is to be expected that in future accelerators there will be continuing increases in the terminal potentials attainable, caused not only by growth in the size of accelerators but also by continued progress in high-voltage techniques which will make possible the insulation of still higher voltages in a given size of accelerator.

3- and 4-Stage Acceleration

A more radical method of seeking higher tandem particle energies is by the use of more than two stages of acceleration. In one possible arrangement for a 3-stage tandem accelerator, the positive-ion beam from the ion source is deflected by an analyzing magnet so that the desired positive ions are directed along the axis of the acceleration tubes. In the neutralizing canal these positive ions encounter an amount of hydrogen which, though relatively small, is nevertheless sufficient to cause the attachment of a single electron to most of the positive ions, thus producing a beam of neutral particles which proceeds to the negative high-voltage terminal. In passing through the electron-adding canal situated in this terminal, some of the neutral particles capture an additional electron and become negative ions. These then receive their first main stage of acceleration in passing from the negative terminal to ground, where they are injected into the second pressure tank as a negative-ion beam of considerable energy. In this tank the beam receives its second and third stages of acceleration.

A 4-stage tandem accelerator could be made by the addition of two 180° deflecting magnets and an additional section of acceleration tube, the target being located inside the negative high-voltage terminal. In the case of the 4-stage tandem, the inaccessibility of the target is a serious disadvantage. However, the effect of this difficulty could be much reduced by the development of special techniques and devices. It thus appears possible that 4-stage tandems may later find usefulness for certain types of research needing mono-energetic positive ions in an energy range somewhat higher than otherwise available.

Dr. Van de Graaff believes nuclear research to be the most promising field for tandems. In these multistage machines, the precision and flexibility of constant-voltage particle acceleration will be available for an increased scope of nuclear investigations throughout the periodic table.

SPE National Officers Elected

At its National Council meeting recently, the Society of Plastics Engineers, Inc. (SPE), elected its national officers as follows: F. C. Sutro, Jr., president; G. W. Martin, first vice-president; J. W. Lindau, III, second vice-president; F. W. Reynolds, secretary; and H. S. Nathan, treasurer. Installation ceremonies took place recently at the Hotel Commodore in New York, N. Y.

AICE Elects Its 1959 Officers

The American Institute of Consulting Engineers has announced the election of G. S. Richardson, of Pittsburgh, Pa., as president; chosen as members of the governing Council are S. C. Hollister, dean, College of Engineering, Cornell University, Ithaca, N.Y.; H. M. Lewis, consulting engineer, New York, N. Y.; and G. T. McCarthy, partner, Tippetts-Abbett-McCarthy-Stratton, Consulting Engineers, New York, N. Y.; elected as vice-presidents are E. H. Praeger, partner, Praeger-Kavanagh, Consulting Engineers, New York, N. Y.; and D. G. Edwards, partner, Edwards and Kelcey, Consulting Engineers, Newark, N. J.

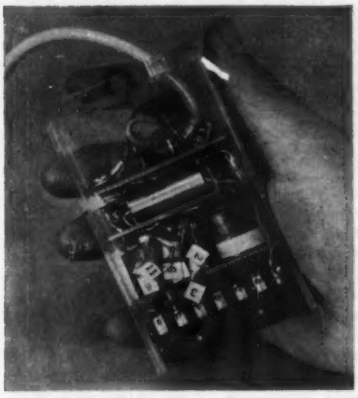
Long Distance Data Input for Electronic Brain of High-Speed Computers

A FURTHER STRIDE in mechanization of time-consuming clerical routines of business and Government was announced recently by the Western Electric Company at a demonstration of a new invention designed for use with telephone company Dataphone service. Dataphone service provides for the transmission of data over regular telephone connections. Thus, this new device, which has not yet been named, will provide multiple access, unlimited by distance, to the "electronic brains" of modern, high-speed computers.

The development was sparked by a search on the part of the manufacturing and supply unit of the Bell System, the Western Electric Company, for better ways of ordering supplies from the company by employees of Bell Telephone companies. Other Bell System applications are under consideration.

Demonstration

An experimental model is currently being demonstrated by company engineers to several Federal agencies and to some 35 business machine manufacturers to acquaint them with its capabilities and to interest them in manufacturing and marketing the transmission device for general public use. Field tests are planned to validate proposed use of the device.



MINIATURIZED Dataphone unit used in Western Electric's experimental data-sending device is transistorized multifrequency oscillator, which plugs into card reader unit.

L. L. Sevebeck of Western Electric, a co-inventor of the equipment, explained that the new facility now being perfected could not be made available to potential users by business machine manufacturers for some months.

He described the problem confronting the company which, it is hoped, use of the new device with Dataphone service will solve. The company, he said, receives about 500,000 large and small orders monthly from telephone companies for tens of thousands of items carried in stock. More direct methods of feeding orders to the Western Electric distribution centers and into data processing machinery would improve efficiency and speed up all phases of filling orders, inventory control, and accounting.

Input at Origin Point

The new device, operating in conjunction with Dataphone service, is designed to move input of data away from the data-processing center to hundreds of originating points. From there data would be transmitted in "machine language" directly to the data processing center with no intermediate steps. Thus, wasteful manual duplication would be avoided. Moreover, Dataphone service permits information formerly mailed to be flashed over regular telephone lines with a consequent saving in time.

Mr. Sevebeck said the electronic apparatus at a receiving center could accept data sent over telephone connections from many scattered points, by means of small, low-cost transmitters like the model being demonstrated. Information flowing from these points into the center could be recorded automatically on paper tape or punch cards which would then be transferred directly into standard data processing machines.

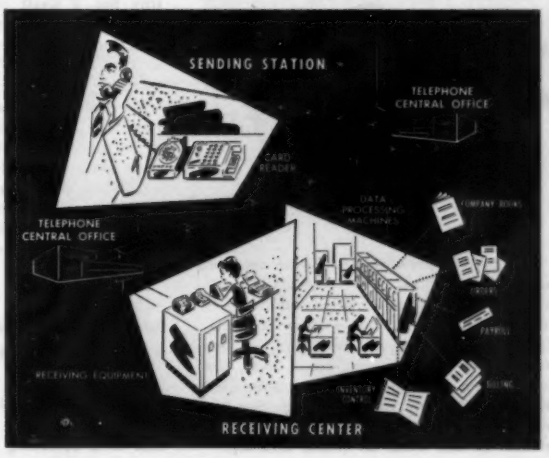
The multiple input feature of the system which is inherent in Dataphone service would help to solve the stubborn problem of making large and costly computers justifiable in the solution of many business problems. Such information is usually assembled, reprocessed, and then checked manually for insertion into the computers or other devices. Computers work at lightning speed and the question has been how to supply enough information to them conveniently and economically in the case of business operations.

Trial Installations

The first large-scale trial of this development will get under way soon with the installation of transmitting and receiving units in the States of New York and Illinois. Telephone company men using the new equipment to transmit orders to Western Electric will have small identification cards, containing code punch marks. They will also have a supply of similar cards with punched code numbers describing items they would have occasion to order.

ENGINEER tries Bell System Dataphone developed by Western Electric. After telephoning the receiving center, he is ready to send business data through compact card reader. This can be done by using either the small punched cards or the numbered pushbuttons.

The telephone company employee using the service would insert his identification card in the card reader—part of the transmitting device. This automatically establishes his authority to order materials and specifies delivery information. Next, he would insert cards corresponding to the items he wished to order. The quantity of each item would be transmitted by



TRANSMISSION steps used in new Bell System Dataphone development. At sending station (top), user's call is made in usual way. When connected, caller sends punched-card or pushbutton data using card reader. Information travels to central offices, then to receiving center where it is connected to receiving equipment by flicking of switch, as card punch (right) records data on cards fed directly to data-processing machines to produce various business records.

pressing numbered keys on the top of the device.

As to possible general users of Dataphone service and the new device, Mr. Sevebeck mentioned salesmen, credit card users, and businessmen as among those who might eventually benefit directly by the convenience of the service. It would connect them to data processing centers in stores, main offices, and warehouses where orders would be recorded, merchandise routed, checks written, and bills made out—all automatically.

Whether data fed into the computers consisted of a lengthy order for goods originating hundreds of miles from the home office, or the time an employee reports for work and leaves, or details of a sale across the counter, the transaction would be processed to completion automatically and error free.

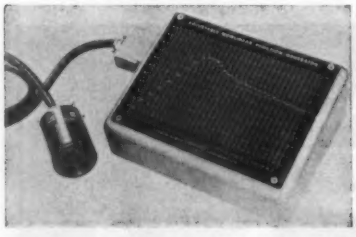
Mr. Sevebeck and his Western Electric assistants, P. J. Grunfelder and M. V. Dilorio, were aided by Bell Telephone Laboratories and the American Telephone & Telegraph Company in the development of this new device to utilize Dataphone service.

Computer with Special Generator for Accurate Missile Firing

A compact computer, utilizing a unique adjustable nonlinear function generator, has been developed by the U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J., to overcome the effects of near-surface winds on missile accuracy.

Because of the relatively low velocity of a missile immediately after firing, near-surface winds have a considerable effect upon its trajectory. To insure that the missile hits a predicted impact point, low-altitude winds must be determined accurately. Pilot balloon runs are made shortly before a firing to measure these winds, and to provide data from which their effect can be computed.

A special computer, which can determine ballistic wind effects rapidly and accurately direct from pilot balloon data, incorporates two adjustable nonlinear function generators developed by the Vernistat Division of the Perkin-Elmer Corporation, Norwalk, Conn. These devices make possible adjustments in nonlinear inputs to the computer with a minimum of time and calculation.



"VERNISTAT" special function generator can be adjusted quickly and easily to provide any mathematical or empirical function, including those with multiple slope reversals. Two of these devices, developed by the Vernistat Division of Perkin-Elmer Corp., are incorporated in a special computer developed by the U. S. Army Signal Research and Development Laboratory, to overcome the effects of near-surface winds on missile accuracy.

Prior to the computer's development, the necessary computations were done manually. Often, by the time the computations were completed, a new set of weather conditions had developed.

The computer displays the data in the form of an X and Y co-ordinate change (north–south and east–west). It provides for an automatic data input from a theodolite, which enables continuous computations. These calculations are completed simultaneously with the completion of each pilot balloon run. The theodolite data consist of two signals, an angle of elevation and an azimuth reading. Other input data are an assumed rate of rise of the test balloon, and a function which relates the effect of the wind on the balloon to the effect of the wind on the missile at various altitudes. This latter function is the *rho* factor.

The balloon's position from the launching site is determined along the north–south and east–west axes from the ground range and azimuth. The *rho* factor continuously converts this to a correction displacement. The computation then is integrated to give net displacement from the "no wind" impact point.

The computer automatically reads out how many miles north–south and east–west the point of impact of the missile will be offset by the ballistic wind. This information is superimposed upon other data characteristics of the particular missile's trajectory, enabling launching tilt adjustments.

Different test balloons have various rates of rise, and these ballistic wind effects upon the *rho* factor vary with different missiles. Thus, it is necessary to have an easy and quick method of changing the input signals in the computer. In the new Army computer, this is accomplished through the use of two "Vernistat" Adjustable Non-Linear Function Generators. These devices enable adjustments of nonlinear inputs to the computer with a minimum of time and calculation. Each of the function generators has a shaft position input proportional to time. The output of the first function generator is a voltage representing the balloon's altitude. The second furnishes the *rho* factor. The Vernistat takes only a few seconds to change one function to another, giving the computer an extreme amount of adaptability. The high resolution and low quadrature of the Vernistat precision potentiometers employed with the function generators are consistent with the high performance requirements of the computer.

Scientific Journal Experiments with Microform

Experimental publication of a scientific journal exclusively in microform—a general term referring to various methods of microfacsimile presentation including microfilm, Microcards, Microprint, microfiches, etc.—is being conducted for the next 3 years by the American Institute of Biological Sciences (AIBS), Washington, D.C.

Under assistance grants from the Council on Library Resources of Washington, D. C., and the National Science Foundation, the journal, *Wildlife Disease*, the official publication of the Wildlife Disease Association, began publication as a quarterly in January 1959.

The purpose of the experiment is to determine (1) whether a small specialist group, unable to afford a journal in letterpress, can do so with microform; (2) whether a microform journal will serve the purpose of scientific communication for author, reader, and library; (3) whether this technique will expedite publication of the results of research; (4) whether, through cost reduction, less abridgement of important data will be necessary; (5) whether photographic reproduction will lend itself to superior presentation of photographic data over half-tone reproduction; and (6) what optima can be found in terms of microtext medium, page size and arrangement, etc.

The journal is published on 5- by 3-inch Microcards, manufactured by the Microcard Corporation, West Salem, Wis., each issue comprising about 4 cards. Each card contains a single article of up to 47 pages in microtext, but bears in full-size type the citation of author, title, and issue number. A leaflet in full-size type accompanies each issue, containing abstracts of the articles; these are reported to *Biological Abstracts*, and it is anticipated, in consequence, that they will not need to be retained permanently.

Optical devices are needed to read the journal, but these are nonportable and expensive. One of the objectives of the experiment, therefore, is to test the applicability of a small, portable, and inexpensive hand-viewer, which is being provided to the original members of the Association at a nomnal charge, and will be available to later members at a cost expected to be less than $10. Although the experiment is being conducted initially with Microcards, it is anticipated that other forms of microtext may later be compared.

Announcement on the International Yard and Pound

The Directors of the following standards laboratories: Applied Physics Division, National Research Council, Ottawa, Canada; Dominion Physical Laboratory, Lower Hutt, New Zealand; National Bureau of Standards, Washington, U. S.; National Physical Laboratory, Teddington, U. K.; National Physical Research Laboratory, Pretoria, South Africa; and National Standards Laboratory, Sydney, Australia, have discussed the existing differences between the values assigned to the yard and to the pound in different countries. To secure identical values for each of these units in precise measurements for science and technology, it has been agreed to adopt an international yard

and an international pound having the following definition: the international yard equals 0.9144 meter; the international pound equals 0.45359237 kilogram.

It has also been agreed that, unless otherwise required, all nonmetric calibrations carried out by these laboratories for science and technology on and after July 1, 1959, will be made in terms of the international units as previously defined or their multiples or submultiples.

> The preceding announcement is being made concurrently by all the laboratories listed above. The following paragraphs provide explanatory material concerning the background and use of the new units within the United States.

The international inch, derived from the international yard, is exactly equal to 25.4 millimeters. This value for the inch has been legally adopted by Canada. Also this value was approved by the American Standards Association for "Inch–millimeter conversion for industrial use" in 1933 (American Standard B48.1–1933), was adopted by the National Advisory Committee for Aeronautics in 1952, and has been adopted by many standardizing organizations in other countries.

At present, for the calibration of line standards and end gauges having nominal lengths expressed in inches, the National Bureau of Standards is using the inch defined by the Mendenhall order (Fundamental Standards of Length and Mass, Bulletin No. 26, United States Coast and Geodetic Survey by T. C. Mendenhall) published in 1893. The values corresponding to this order are approximately: 1 yard equals 0.91440183 meter; and 1 inch equals 25.4000508 millimeters. These are derived from the exact relation: 1 yard equals 3,600/3,937 meter. The inch used by the National Physical Laboratory of the United Kingdom for its calibrations is defined by the equation 1 inch equals 25.399956 mm. It will be noted that the International Inch is approximately 2 parts per million shorter than the inch presently used by the National Bureau of Standards, and somewhat less than 2 parts per million longer than the inch now used by National Physical Laboratory. To avoid possible confusion, during the transition period National Bureau of Standards calibrations of length or mass expressed in English units will embody a statement indicating clearly the unit which has been used if the choice introduces a significant difference in the calibration values. Furthermore, if the accuracy of the calibration is such that the certified values would be the same in either "International" units or the older units, the qualifying adjective "International" will not be used, i.e., the values will be expressed, for example, as so many inches or pounds.

The Coast and Geodetic Survey has requested the following exception with which the National Bureau of Standards concurs.

> "Any data expressed in feet, derived from and published as a result of geodetic surveys, shall tacitly bear the relationship: One foot equals 1,200/3,937 international meter. This relationship shall continue in being, for the purpose given herein, until such a time as it becomes desirable and expedient to readjust the basic geodetic survey networks in the United States, after which the ratio, as implied by the international yard, shall apply."

This unit shall be referred to as the American Survey Foot. Inasmuch as there is little or no interchange of survey data, where the foot measurements are used, with industrial and scientific data, where the international units will be used, it is anticipated that no confusion will result from this dual usage. For example, base line surveys which might enter into a velocity of light determination would invariably be made in terms of meters.

The values of the pounds currently in use in the United States, United Kingdom, and Canada are as follows:

1 U. S. pound	= 0.453 592 4277	kg
1 British pound	= 0.453 592 338	kg
1 Canadian pound	= 0.453 592 43	kg
1 International pound	= 0.453 592 37	kg

The relative differences in the various pounds are substantially less than in the yards but since masses can be measured with greater accuracy than lengths, the differences can be significant. The present British pound is about one part in ten million smaller than the international pound, whereas the U. S. and Canadian pounds are about one and one-half parts in ten million larger.

The conversion factor for the international pound was selected so as to be exactly divisible by 7 to give the following value for the grain: 1 International grain = 0.06479891 gram.

The grain is the common unit in avoirdupois, apothecary, and troy pounds. There are 7,000 grains in the avoirdupois pound, and 5,760 grains in both the apothecary pound and the troy pound.

The standard United States gallon and the Imperial gallon are so substantially different that a compromise international gallon was not practicable. The United States gallon is defined as equal to 231 cubic inches. On the other hand the Imperial gallon is defined as the volume of 10 pounds of water under specified standard conditions. A fairly exact relationship is 1 Imperial gallon = 1.20094 U. S. gallons, or less exactly 1 Imperial gallon = 6/5 U. S. gallons.

Electronic Control of Coating and Combining Unit

The fabrication of pressure-sensitive tapes, adhesives, and allied rubber products has been put into a production basis at the modern facilities of the new Johns-Manville Dutch Brand plant in Chicago, Ill., according to company engineers.

The new facilities utilize the latest mixing, coating, slitting, and combining equipment now available in the rubber and chemical industries in an electronically controlled, automatic system of manufacture.

Increasing former production capacity by more than 50 per cent, the new plant has already made possible the fabrication of a line of entirely new and improved products, including paper masking tapes, strapping tapes, paper electrical thermosetting and nonthermosetting tapes, Mylar (polyester) electrical tapes, cloth thermosetting electrical tapes, transparent acetate electrical tape and cloth nonthermosetting electrical tapes.

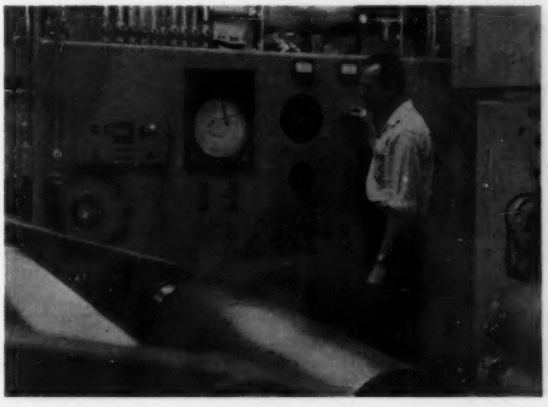
It is based on a single-story, straight-line layout with the flow of materials going directly from a mixing room on the north side to a shipping area on the south side.

The coating equipment, built to Johns-Manville specifications by the Frank Egan Company, is completely electrically controlled and operated with application settings as fine 3/10,000th of an inch.

The release coater, capable of coating 48-inch and 60-inch wide webs at a speed of 40 yards per minute, is of the print roll, two-temperature-zone type with an over-all oven length of 70 feet.

The anchor coater is also of the print roll type capable of coating 48-inch and 60-inch wide webs at a speed of 40 yards a minute. A 40-foot oven is provided for drying in a single temperature zone.

A new adhesive coater is supplied with two coating heads, one of the reverse roll type, a second of the knife over-roll type. Both heads are electronically controlled



ELECTRONIC CONTROLS govern mechanized manufacturing progress at the Johns-Manville new Dutch Brand Division plant in Chicago, Ill. The system of electronic controls, built to specification by the Frank Egan Company, permit coating applications as fine as 3/10,000ths of an inch at speeds as high as 40 feet per minute.

and are designed for interchangeable operation. Three temperature oven zones provide 120 feet of drying area. In addition, the adhesive coater is supplied with a 20-foot refrigeration zone for cooling purposes.

All coating lines are equipped with safety controlled motor drives synchronized to the main electronic control panels to provide for efficient operation.

Slitting of the coated base materials is accomplished on both rotary-knife slitters and slicing-cutters depending upon the type and specifications of the tape manufactured.

Specially designed and custom-engineered tapes are cut and wound on an electronically controlled Dusenbery slitter. This equipment allows for special tension settings and speeds and is expected to play an important role in the development of many new tapes which could not be handled on other types of slitting equipment.

One of the important new processes at the new plant is a unique "combining" unit. It is the first equipment of its type ever designed from the factory floor up to the specific job of laminating parallel strands of organic or synthetic materials on flexible sheets required in fabricating new and improved products.

Essentially the laminating of glass fiber or other synthetic or organic yarns to other materials on flexible flat sheets to give them added strength and new uses, in the process, various materials such as paper, plastic films, or metal foils are bonded under pressure to fine strands of yarn ranging from as few as 12 or as many as 100 parallel strands per inch, depending on the strength desired or other factors.

Typical of Dutch Brand materials designed to meet customer requirements in the nation's rapidly changing technology is a broad range of insulating tapes for manufacturers of electrical equipment and instruments; gasket materials and masking tapes for the automotive industry; tapes for sealing duct insulations; and adhesives for the construction industry.

Reinforced Mylar sheets have been produced on the combining equipment for use as insulators and supports for mica splits used by industry. Metal foil, reinforced by parallel plastic strands and laminated to asbestos paper, has been fabricated as an exceptionally effective, strong and dimensionally stable pipe wrap. Rubber sheeting, reinforced with parallel plastic strands, has been made experimentally on the unique equipment as a protection for service entrance cables.

One new material developed on the combining machine was originally created to protect U.S. Navy shipboard cable. In this case, fire-retarded asbestos paper as thin as cigaret paper, and having unique dielectric properties, was laminated with parallel strands of glass fibers, 15 strands to the inch. It made an effective cable covering and, with slight variations, can be utilized in producing other new materials.

Powder Pattern Technique Shows Ferroelectric Domains

A new method for delineating the domain structure at the surfaces of ferroelectric crystals was described recently by G. L. Pearson and W. L. Feldman of Bell Telephone Laboratories. It has been used to delineate domain structures in great detail on a wide variety of crystals in which domains have never been observed before, according to a paper presented at the American Physcial Society meeting in Chicago, Ill.

According to its discoverers, the method should be applicable to the study of piezoelectric and pyroelectric charged surfaces as well as ferroelectric materials.

The new technique uses colloidal suspensions of electrostatically charged powders in an insulating organic liquid. When a few drops of this suspension are applied to the face of the crystal, the charged powder is immediately attracted to the ferroelectric domains carrying an opposite charge, and covers their entire area.

The most effective materials for this work are commercial spray-grade sulfur and red lead oxide, each suspended in hexane. The sulfur deposits on negatively charged domains, while the lead oxide deposits on the positively charged domains. Each of the suspensions is applied separately; the second is not applied until the hexane in the first has evaporated. If the two suspensions mix on the crystal surface, each may lose its charge. In this event, no pattern is formed. The powders are fixed in place indefinitely by their electrostatic charge after the hexane evaporates.

The yellow sulfur and red lead oxide provide brightly colored delineation of the positive and negative domains, and the pattern shows great detail.

A dispersion of a cross-linked polymer derived from polystyrene can also be used as the negatively charged colloid, in place of the lead oxide. This can be dyed any desired color with an oil-soluble dye.

The basis for the success of the new technique lies in the fact that although the colloid as a whole is electrically neutral, individual particles acquire a diffuse, double-layer charge when brought in contact with the liquid. Under the influence of the "built-in" electric field, the colloidal particles are attracted either to the positive or negative domains depending on the orientation of their dipole layers. For these experiments, an insulating liquid of low viscosity and low dielectric constant such as hexane is desirable, so that the charged particles are free to move toward the ferroelectric domains under maximum electrostatic attraction.

Powder patterns of an entirely different nature result if a colloid of finely divided barium titanate in hexane is used instead of sulfur and lead oxide. The $BaTiO_3$ particles carry no net electric charge, but they do have a very high dielectric constant. Thus, when they are placed on the surface of a ferroelectric crystal containing positive and negative domains, the particles polarize in the external electrostatic fields and are deposited at domain boundaries where large field gradients exist. The resulting powder patterns outline the domain boundaries well, but do not differentiate between positively and negatively charged domains.

This new technique has provided the first information available on the domain structure of a number of crystalline ferroelectric materials, including triglycine sulfate and guanidinium gallium selenate hexahydrate. Previous optical determinations which have been made on Rochelle salt, and domain etching procedures on barium titanate have been confirmed by the new method also.

Thus, a simple, easily employed technique joins the group of tools available to the physical chemist and physicist in their continuing search for knowledge of the ultmate structure of matter.

CLOSE-UP of triglycine sulfate crystal, showing ferroelectric domain patterns, delineated by new powder technique developed by scientists at Bell Telephone Laboratories. Crystals in foreground include other samples of triglycine sulfate and a hexagonal crystal of gadolinium aluminum sulfate hexahydrate (GASH).

Sandwich Aluminum Used for New Refrigerators

A method of manufacturing refrigerator cabinets, which requires very little tooling cost and permits profitable production of small quantities of special models, has been developed recently by Westinghouse Electric Corporation, Columbus, Ohio.

The new method involves the use of a "sandwich" of aluminum sheets bonded to expanded polystyrene bead insulation. Both built-in and free-standing refrigerators are being manufactured by the new process.

The panels or sandwiches, supplied by the Aluminum Company of America, are

delivered in rectangular shapes cut to the lengths and widths required for the particular size refrigerator to be produced. Ordinary electric saws notch out or miter corners. The sandwich is then folded into the cabinet shape and the corners are sealed with polyurethane foam.

With the cabinet completed, the balance of the refrigerator is assembled by conventional methods.

Two years ago Westinghouse first experimented with sandwich materials, but used plastic outer "skins." J. W. Craig, Westinghouse vice-president and general manager of the electric appliance divisions, said the new method ultimately may drastically revise refrigerator manufacture.

He said the method has potential application to almost any appliance or other item where the ultimate product has what amounts to three layers of different materials forming a cabinet or shell.

Westinghouse is producing a 13-cubic-foot horizontal built-in refrigerator and freezer combination and a 5-cubic-foot upright refrigerator. Both cabinets are made on the same set of jigs and fixtures.

With the new method, it will be possible to produce in quantities of 1,000 or even less, provided they can accommodate component parts used in refrigerators made by standard methods.

Performance-wise, refrigerators made with sandwich construction are substantially more efficient than today's standard models, Mr. Craig said. Temperatures within the refrigerator are better controlled than in any standard refrigerator. The insulation is more moisture-proof and retains its thermal efficiency permanently, never settling. He said extensive laboratory tests under high humidity and temperature conditions had been used to compare the new models with traditionally made refrigerators.

Helicopter Transportable Communications Network

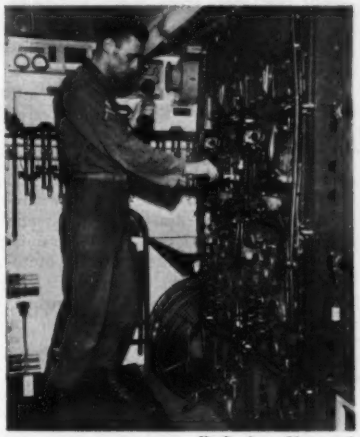
Development of a new highly mobile, air transportable communications center, designed to direct fast-moving U. S. Army forces was announced by the Department of the Army recently.

The system, which has an extremely high degree of mobility, can be set down almost anywhere by helicopters, and be flown out immediately for relocation elsewhere. It can also be moved rapidly from place to place on conventional Army trucks.

Developed by the U. S. Army Signal Corps, Fort Monmouth, N.J., it provides the vital nucleus for a communications network of radio, telephone, telegraph and teletypewriter combat links. The system can be carried by helicopters to a remote destination in hours rather than days, or can be set up on otherwise inaccessible mountain tops. With its communications tentacles spread over hundreds of miles, the new system can get an urgent message through to a distant outpost even with direct lines broken or destroyed.

Speed and flexibility in communications would be vital on a battlefield where troops would have to be continuously on the move and widely dispersed to avoid annihilation by a nuclear warhead. For quick transportation and added versatility, the center is made up of separate aluminum houses or "shelters," each fully equipped and independent. These can be hooked up quickly to fit any battle situation. Small centers for the front lines would have two or three shelters; large headquarters would have as many as 24. Each shelter carries its own independent supply of electricity, but can also plug into a central power source.

High priority combat messages flowing into the center from combat groups and other sources would be immediately available to the Army field commander. And the same network of communications lines carries his message with reflex speed to higher headquarters or to hard-hitting Army combat elements. The new system, the first fully air transportable message center of its kind, is the result of 12 years of design and research.



U. S. Army Photograph

RADIO EQUIPMENT inside U.S. Army airborne communications center is operated at Fort Monmouth, N.J., Signal Research and Development Laboratory where it was designed for use of combat commanders to enable better control over widely dispersed troops on an atomic battlefield.

Metallurgist Awarded AIME Douglas Gold Medal

Clyde Williams, renowned metallurgist and former president of Battelle Memorial Institute, has been awarded the James Douglas Gold Medal of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), one of the most distinguished honors in the field of metallurgical science. Formal presentation was made the evening of February 18, at the annual AIME banquet, during its national meeting in San Francisco.

Established in 1922, the specific citation drawn up by the AIME Board of Directors in this instance states that the Medal goes to Clyde Williams "for outstanding contributions in nonferrous metallurgy particularly through stimulating research and interest in the basic metallurgy and the use of both the common and less common metals."

He did an outstanding service in the development of Battelle Memorial Institute, serving as assistant director, director, and president. While in that service, he helped establish research laboratories in Switzerland and West Germany to serve European industries.

In superalloys he has done distinguished work with nickel, chromium, columbium, tungsten, molybdenum, cobalt, and tantalum. He has been highly active in research involving titanium and zirconium and on gallium, hafnium, and indium. He is credited with outstanding achievements in the iron, steel, aluminum, magnesium, lead, zinc, tin, and copper industries.

In World War II, he was chairman of six civilian committees advising the War Production Board and other Federal agencies on material policies and acting as liaison between Government and industry in establishing and executing war research. Dr. Williams was chairman of the War Metallurgy Committee of the National Academy of Science. He was Chairman of the War Metallurgy Division of the Office of Scientific Research and Development. For these and associated activities he received a Presidential citation and the Medal of Merit. He has done distinguished work for the Atomic Energy Commission and was on a subcommittee of the Hoover Commission. He was a member of the Stockpile Com-

U. S. Army Photograph

HELICOPTER transports airborne combat communications center designed to co-ordinate atomic-age warfare. The unit is complete teletypewriter room with facilities to service an area hundreds of miles square. Other shelters carry radio, telephone, telegraph and other vital links, and are equally light and transportable. All were designed by U.S. Army Signal Corps engineers at Fort Monmouth, N.J.

mittee of the Office of Defense Mobilization and recently was named to important service to the new subcommittee on military applications, of the Joint Committee on Atomic Energy.

Pushbutton Operated Streamlined "Add On" Telephone

A streamlined pushbutton telephone for people in business who make or take a lot of calls is unlike any previous telephone.

The new instrument, the "Call Director," is a low, compact button-studded unit with hand receiver cradled at its side. It has special features that should make life easier for busy executives and for secretaries or clerks who answer calls for a number of people.

At the touch of a button, it can provide interoffice communication, arrange conference calls, and "add on" other extensions to incoming calls.

The Call Director was tested in a six-month trial among business customers in New York City. Bell System companies will introduce two models; one provides up to 18 pushbuttons, a larger model has up to 30 pushbuttons.

The new phone was developed by Bell Telephone Laboratories and consulting industrial designer Henry Dreyfuss. It assembles components on a modular principle. The hand receiver and dial are like those on a standard desk phone. The cambered housing, square translucent buttons, and "domed" finger wheel are new. These basic elements can be arranged to give subscribers as many as 30 buttons or as few as 12, depending upon the user's personal requirements.

The clear plastic pushbuttons light up to indicate incoming calls, lines in use and lines on which calls are being held. The names and numbers beside the buttons appear in rectangular illuminated windows. Designations are typed on individual cards, quickly inserted or removed.

The dial and pushbuttons are controls that require very different types of hand motions. This necessitated precise human engineering study to decide on the angle of the control panel. An angle of 26 degrees was selected for efficient dialing, comfortable button operation, and readability.

In profile, the new "domed" finger wheel on the dial is a flattened, convex arc. It improves dialing efficiency and simplifies cleaning and installation.

A major problem in appearance design was to minimize the size of the unit. This was achieved by a low silhouette, accentuated by curving front and back edges. The translucency of the pushbuttons minimizes their size, yet adds a decorative crystalline touch.

The square design of the pushbuttons increases their surface area, to give the finger a better target. This shape also takes into consideration the fact that many women users will be accustomed to similar keys on their typewriters.

Bell engineers say the instrument's special design makes possible fast installation and rearrangement of service, with a minimum of inconvenience to telephone users.

The sets will be available in four colors —light gray, moss green, ivory, and beige.

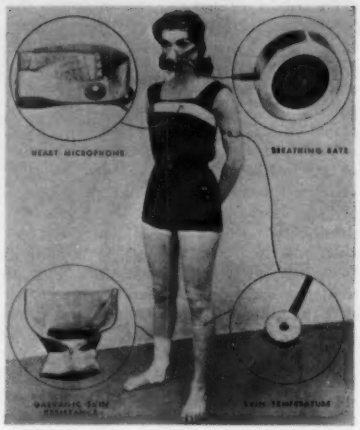
Medical Electronic System Measures Physiological Data

A 20-pound package of medical instruments that will measure the physiological condition of man in space, was shown recently. The new medical electronic system was developed by the Vibro-Ceramics Division, Gulton Industries, Inc., Metuchen, N.J.

According to Irwin Steinberg, general manager, "human beings will soon be launched in space vehicles and all haste must be made to learn just how severe the physiological stresses are which they will be undergoing.

"Since it will be impossible to send along a doctor with each space vehicle," Mr. Steinberg explained, "a miniaturized electronic system that is lightweight, which can be worn comfortably and which can withstand the environmental conditions to be encountered in space, is the next best thing."

NEW LOOK in telephones is the "Call Director," developed by the Bell System for busy executives and for secretaries or clerks who answer calls for a number of people.



Six physiological parameters can be measured which will reveal useful information about blood pressure, heart rate, heart sounds, respiration rate and depth, skin temperature from many points on the body and galvanic skin resistance.

Additional characteristics of the system, it was stated, include gathering of continuous and accurate bioelectric and physical information. All equipment is designed to operate in extreme environmental temperatures, as well as under acceleration conditions of up to several times the force of gravity.

Blood Pressure Measurements. Blood pressure measurements will be performed with the pilot wearing an occluded cuff at the finger *(not shown)*. A microphone pickup mounted in the pressurized cuff will relay the sounds and by utilizing the time of appearance and disappearance, will measure systolic pressure. Measurement of the sensitive blood pressure changes will indicate the subject's reaction to abnormal environmental conditions.

E. K. G. and Heart Rate. In measuring the heart rate, the E. K. G. waveform is used. Using a standard lead location the contraction of the heart muscle is measured to indicate cardiac disorders. For example, if there is a lack of oxygen the heart will have to work faster to supply more of it to the body. In animal studies it has been recorded that heart rate has been more than 3½ times normal under missile or rocket takeoff conditions.

Heart Microphone. Essentially a ceramic microphone that performs the function of a stethoscope, the heart microphone is mounted in an elastic chest band *(see picture)* and positioned over the heart. It can be utilized to determine malfunctions of valves in the heart under the severe conditions present in missile takeoff.

Respiration Rate and Depth. These physiological parameters will be measured by a strain gauge *(worn by model)* mounted in a face mask. In the waveforms that will be produced, the rate of the major waves will determine the respiration rate and the amplitude is calibrated in terms of flow rate, so that the peaks and troughs yield respiration depth. The readings will indicate whether the subject is undergoing strain, if he is coughing or gasping and just what his breathing reactions might

be to high speed, elevated temperatures and rarefied atmosphere.

Skin Temperature Measurements. The advantage of this electronic medical instrument is its ability to record accurate skin temperatures from anywhere on the body within a half second. With temperature sensing probes *(seen on model's upper arm and calf)* located on the forehead, chest, back, arms and legs, it will be possible to record almost instantaneously change of body temperature as well as give information which can be related to the subject's circulation. The instruments are so sensitive that if the subject is a non-smoker, a puff on a cigarette will immediately indicate a temperature change.

Galvanic Skin Resistance. Galvanic skin resistance will be measured and recorded from electrodes placed on the insteps of both feet and which will be contained inside of flexible spats *(worn by model)*. These electrical measurements will determine the changes in emotional activity or response of the pilot and his reactions to stimuli. The subject's skin resistance will change in anticipation of a danger within seconds after he becomes aware of it.

Thus, tomorrow's physical check-up may be performed by an electronic machine that will diagnose a case in 30 seconds and present its findings on a 3 by 5 punch card.

The "electronic doctor" will probably be similar to a pilot's wired space suit. With the perfection of additional electronic techniques, one can envision the day when a man will be able to step into a wired medical suit, and get a complete physical examination in 30 seconds. Similar to the manner in which the operation of machinery is tested today by electronic means, a punch card will be stamped for the doctor telling him what the examination's findings are, thereby enabling him to treat the patient.

Scientists Study Ice More than 800 Years Old

An "icicle" treasure trove of frozen historical facts including perfectly preserved samples of air more than 800 years old is under study by Government scientists near Chicago, Ill.

An electronic computer will be used in an accelerated study of Arctic ice which nature has used as a "deep freeze" to store information never before available.

Government researchers obtained the "icicle," a core 4 inches in diameter and more than 1,300 feet long, by drilling deep into the Arctic ice, said R. C. Whiting, midwest regional manager for the Computer Division of Bendix Aviation Corporation.

From the ice, scientists should be able to garner a wide variety of information such as how much air contamination—if any has resulted since the industrial revolution, Whiting pointed out. The ice core, for example, contains trapped samples of air preserved from the days when Washington breathed at Valley Forge, Columbus sniffed at sea, and King John gulped at the time of the Magna Carta.

It contains a permanent record of facts such as total annual atomic fall-out since Hiroshima and Nagasaki, and will enable scientists to determine how much snow has fallen in the area each year from about 1100 A.D., the year the oldest part of the core was believed formed. Even bacteria that existed as far back as the year 1100 are believed to be preserved in the ice perfectly and available for study.

The core was drilled from the Greenland icecap some 200 miles east of Thule by a research team from the U.S. Army Snow, Ice and Permafrost Research Establishment (SIPRE) headquarters in suburban Wilmette, Ill.

Large portions of the core were brought back to the SIPRE laboratory in Wilmette for analysis and study. Mr. Whiting said a *G-15* general-purpose digital computer recently installed by Bendix at SIPRE will help scientists speed the detailed and complex job required to "thaw" the secrets frozen into the ice core.

Dr. Henri Bader, chief scientist at SIPRE, explained that the icecaps at Greenland—and the Antarctic—represent a "treasure trove for the scientist. We can now reach back into the past for information otherwise unobtainable," Dr. Bader said. "Every snowfall and everything that fell with it are, so to say, separately and safely filed for future reference by being buried under later snowfalls. Natural objects which fell with the snow such as volcanic ash, meteorites, spores, and bacteria are perfectly preserved year by year for anyone who is interested in them. Scientists who have been monitoring radioactive fallout can go back to the icecaps to measure some things they missed at the beginning," he added.

Although scientists have long known about the icecap "treasure trove," they could not exploit this source fully till the development of deep drilling techniques by SIPRE in 1956 and 1957. C. C. Langway, Jr., who is in charge of the SIPRE Greenland deep drill core investigation, said that samples of air from each of the past years have been trapped in the ice and preserved as bubbles. When the bubbles are analyzed, the content and composition of the air for any given available year can be determined, he said.

Identifying the year-by-year accumulation of the icecap is relatively simple, according to Langway. In most cases, the annual accumulations are separated by "rings" that are easily distinguishable.

Ash from the Katmai volcanic eruption of 1912 in Alaska was identified in ice about 70 feet below the surface. Langway said he expects ash from the Krakatoa eruption of 1883 to be found at about 160 feet below the surface.

The core drilled in Greenland was sawed in half lengthwise at the site. Half the core is being stored in Greenland. About 200 feet of selected sections were cut to 6-foot lengths, packed in dry ice and shipped to Wilmette. Tests were made at Greenland and at the SIPRE Wilmette laboratory for any structural changes in the ice caused during handling and shipping.

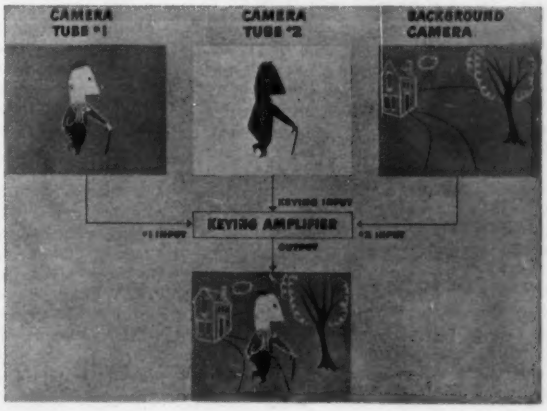
Langway said that co-operation of SIPRE scientists and IGY scientists, working on a similar drilling operation in the Antarctic, also should result in a great deal of information about the movements of air masses.

Vast New Area Created by VideoScene

In a major technical development giving the "live" television studio vastly broadened, new production abilities and unlimited variety of scenic settings, the Columbia Broadcasting System (CBS) Television Network has perfected a new device called the VideoScene, it was recently announced by L. G. Cowan, president of the network. The device, which was demonstrated to the press at the CBS Television Network's Studio 50 in New York, N. Y., was used for the first time on "The Ed Sullivan Show" Sunday evening February 8.

The VideoScene, designed by the CBS Television Network Production Development Department, is an electronic camera system which makes it possible to blend live action with miniature settings, still photographs or motion pictures in such a way that the actors become part of the reproduced locale.

Under development for more than 3 years by CBS, the VideoScene represents a real "breakthrough" in overcoming the restrictions of previous composite picture systems whose use in both motion pictures and television has been limited because of



VIDEOSCENE technique uses master camera with two picture tubes. One photographs actor against special reflective background while second tube produces silhouette of actor and blacks out background. Background camera photographing miniature set feeds its picture into keying amplifier, where background picture is combined with picture of actor as a single scene.

camera immobility. By linking together the cameras on actor and miniature set with servo systems, so that the two cameras move and focus together synchronously, the VideoScene can pan to follow the actor while the composite picture remains realistic. With this limitation removed, a facility formerly restricted to the production of special effects now becomes a brand new tool available for regular programming purposes.

The actors perform against a background of special reflective material. Through the use of a keying light, the reflective background is rendered invisible and the miniature setting blended into the final picture in its proper place.

The combination of exceptional brightness and color sensitivity provides several advantages:

It insures a sharp, clear cutout of the actor's image from the scene viewed by the other camera, thus eliminating blurring caused by over-printing a scene on the actor.

It permits fine gradations of grays, so that the slight differences in brightness between (for example) ocean white caps, white sand, and a white bathing suit remain distinctly visible, instead of tending to blend into a single blur of whiteness.

It makes possible scenes that could not be done realistically in the studio before—beach, snow, and desert scenes; dark jungle scenes and night-time city street scenes; darkened rooms; and scenes in which the actor can walk in and out of miniature settings as realistically as if they were life-size.

It allows any color of set or costume except a brightly lighted vivid blue.

Surveillance Drone Tested Successfully

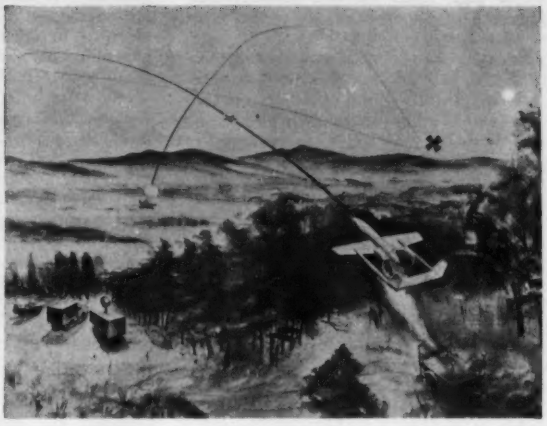
Four successful test flights of a new, miniature flying "snooper" were announced by the Department of the Army, Washington, D.C.

The aircraft, a remote-controlled drone designated the *SD-3*, was built for the U.S. Army Signal Corps by the Republic Aviation Corporation. Designed to observe enemy battlefield activities, it was flown successfully at the Army's test center facility in Yuma, Ariz. Longest of the four flights lasted more than 30 minutes.

Weighing less than half a ton and only 15 feet long with a wing span of 11 feet, the *SD-3* is packed with electronics and advanced sensory devices for guidance control and observation of enemy troop movements, fortifications, and battlefield installations.

Interchangeable nose units enable rapid switches from one surveillance technique such as photography, infrared, radar, or television, to a different type, depending on mission requirements.

Produced by Republic's Guided Missiles Division, Mineola, L.I., N.Y., the drone is powered by a 140-hp Continental engine. In a typical mission the drone is launched from a mobile trailer by two Arrow II rocket motors. Once in the air the reciprocating engine takes over.



ARTIST'S CONCEPT of the SD-3 drone flying a front-line surveillance mission. Zero-length launched from a mobile platform, the drone flys out over point X in enemy territory, accomplishes mission using one or more sensory techniques, returns to take-off point and is recovered by parachute. Control vans are shown in left foreground.

Landing is accomplished by an automatic parachute device which floats the drone back to earth. Special inflatable rubber mats, contained within the drone, cushion the fall.

Drone missions can be programmed in advance for automatic flights or can be controlled from a ground monitoring station.

Although the *SD-3* has an operational capability at varying altitude, most missions are accomplished at low level where the drone's tiny size and speed aid in dodging enemy radar and guns.

Future Space Migration Seen by Prominent Scientists

Is there the possibility that some time from now a good portion of the earth's population will be living elsewhere in the universe? "Yes," says Dr. A. R. Kantrowitz, director of AVCO Research Laboratories. "Migrations have always been a result of people running away from something, not toward something and you don't have to look far today to see the pitchfork." He referred to the potential power of nuclear energy which he said "needs the vastness of interplanetary space" to make a situation we can live with. If space migration is a possibility of the not-to-distant future, then what of the more distant future asked another panelist. "Will there be a back-to-earth movement?"

Four prominent space scientists participated in a panel on "What the Future Holds for Man in Space." They were Dr. H. G. Stever, former chief scientist, U.S. Air Force, and associate dean of Engineering, MIT; Dr. A. R. Kantrowitz, director of AVCO Research Laboratories and vice-president of AVCO Manufacturing Corp., Dr. Martin Schilling, missile program manager for Raytheon, former chief of programs management staff, Redstone Arsenal, and member of the German Rocket Team at Peenemunde; and Dr. F. L. Whipple, director of the Smithsonian Astrophysical Observatory.

"Man is really needed in space for exploration," said Dr. Whipple, "but, at present, remote control equipment can do better." He said that lightweight telemetering devices can accurately read up to 100 instruments, something which man, bothered by discomfort and other factors, cannot do.

Dr. Whipple felt that using such instrumentation, artificial satellites reporting via automatic computers could transform meteorology from an art to a science. Meteorological satellites could give wider coverage, more frequently, and using computer techniques, would enable us to put the results to better use.

What does the future offer in the field of useful engineering applications? Dr. Schilling described communications satellites which could solve problems of presently glutted communications channels. They would eliminate transmission problems related to earth curvature. One such program using 30 satellites could adequately cover the entire globe he said and far fewer would serve the United States. Passive satellites, requiring no internal working parts, they would serve as reflector-relays handling simultaneously military, civilian, and commercial traffic with no interference of interest.

"No revolutionary discoveries are necesary," said Dr. Schilling. "Microwave power is now available and other techniques required are now known. We have only to do it."

With active satellites, those containing mechanisms to scan, to relay television signals, to power space engines, etc., there are still pressing problems. Solar energized power supplies must be built to deliver high electric power per pound of weight. Three of these active communication satellites, at an altitude of 22,500 miles, would be able to communicate with any point on earth.

A point repeatedly stressed by Dr. Kantrowitz was that with regard to bold, new developments in space technology whether electrical propulsion systems for interplanetary travel or higher thrust rockets, "We'll have them just as soon as we need them. . . . Like so many other things, it will take us less time to do it than to make the decision."

"It is a rare situation when a brand new art gives promise of paying for itself so rapidly," said Dr. Kantrowitz. He felt space exploration will pay for itself in commercial applications alone and cited as just one example, the communication

satellite's ability to do better and easier, the job done by transatlantic cables costing about $60 million each. Apropos of financial support for the space program, it was noted that only a short while ago we could not even afford an editorial on the jet age.

The panel discussion held at MIT's Kresge Auditorium was the last in a series of presentations on "Space Technology—What the Future Holds!" sponsored by three New England research firms, A. D. Little, Inc., Raytheon Manufacturing Company, and Technical Operations, Incorporated.

3,000 Years of Fiber Glass Manufacture

Although the manufacture of fiber glass has become an industry only in the last 20 years or so, the history of this unique, man-made fabrication material goes back to the Phoenicians, who had learned the art of glass making from the Egyptians. The Phoenicians used fiber glass ornaments about 3,000 years ago. Their fiber glass was made by heating glass balls until they had become pliable, then stretching them into crude strings.

The first research scientist to produce fiber glass in the United States was E. D. Libbey. He worked out a laboratory process that produced strands of fiber made from molten glass that could be bent, twisted, knotted, or woven without breaking. His laboratory achievement was dramatized at the Colombian Exposition in Chicago in 1893. A pretty model was used there to demonstrate a dress made entirely from fiber glass yarn. But fiber glass was destined to remain a laboratory curiosity for many years.

In the late 1920's the Germans began producing a crude type of glass fibers on a business scale. As in the days of the Phoenicians, they used it only for ornamental purposes. The glass fibers were not uniform. This limited their functional usefulness.

A decade later glass researchers in the U. S. turned to fiber glass to expand sagging glass markets. Their initial research and development work produced a more highly refined type of fiber glass. It was used in the production of efficient, throwaway fiber glass air filters. Later, some coarse-fibered, effective glass insulation for buildings was produced.

World War II gave new impetus to the manufacture of fiber glass. Industrial research scientists developed a lightweight, fireproof insulating blanket made of fine fiber glass. This "glass wool" was used to insulate "Victory" ships and "Liberty" ships. Total fiber glass sales jumped in the war years from $15 million in 1939 to $40 million by 1944.

These increased fiber glass sales helped pay for further industry research and development of the new fabrication material on a more widespread basis. Today, highly specialized fiber glass studies are being continued at the Johns-Manville (JM) Fiber Glass Research Laboratories at Waterville, Ohio, headed by Dominick Labino.

Researchers at J-M Laboratories make use of the patented Barnard process in which crucibles made of platinum—more costly than gold—are heated to about 2,700 F by radiowaves transformed into heat energy. This has made possible many varieties of thermal, electrical, and acoutical products, and glass textiles of high quality. The application of high-frequency induction heat distinguishes the Barnard process from other methods that use electrical resistance in heating individual crucibles.

Fiber glass of great uniformity in diameter is made through electronic extrusion by forcing molten glass from tiny holes in the platinum crucibles. Two products are possible with this patented equipment. Under one method, the fibers emerge as a woolly mass and are bonded by resins for use in insulation blankets. The other process produces glass strands at the rate of 2 miles a minute ready to be twisted and plied into flexible yarns.

One remarkable laboratory product recently developed is based on the chemical duplication of natural quartz. This is the crystalline form of silica widely regarded as the most perfect electrical insulating material found in nature.

Its duplication chemically in the Fiber Glass Research Laboratories was the first step in producing a new fiber in submicron size which is utilized in manufacturing a quartz paper that is highly resistant to radiation. This new quartz paper has a temperature resistance up to 3,000 F and provides minimum electrical losses at high frequency. In extensive tests reported by the U.S. Naval Research Laboratories, it has proved relatively unaffected by atomic radiation. The quartz paper is free from magnitite, making it exceptionally efficient as a nonconductor of electricity. It does not break down chemically.

Production of this quartz paper, which duplicates nature, is considered by industry observers to be the most important development in the glass industry since the invention of the automatic bottle blowing machine and development of equipment for the manufacture of flat glass.

It has already proved its efficiency as a wrapping insulation on all types of wires, cables, and components used in the radiation field, including coaxial cables, magnet wires and wave guides. It makes possible the production of much lighter weight condensers for high-speed, high-altitude aircraft and missiles, thus increasing their working pay load.

Fiber glass combined with plastics has proved almost indestructible. Inasmuch as it will not rot, fiber glass has replaced other materials in life preservers. It is used for pipe wrap on underground oil and gas lines otherwise subject to corrosion. It also damps sound when used acoustically.

AIChE Meeting Highlights Reported

Incentive to Minimize Water Usage. Because of rising water costs and increasingly strict requirements for pollution control, the incentive to reduce water usage becomes imperative. Cost of treating wastes frequently amounts to several times the original cost of water, but the certainty that in numerous areas throughout the country the cost of water will rise markedly necessitates quantitative as well as qualitative waste reduction by good housekeeping. The proper kind of information should be made available to operator, designer, or supervisor of metal finishing equipment so that water usage in a continuous rinsing operation can be reduced by use of countercurrent system.

Air Cooling Cheaper than Water. In many refinery applications, even in locations where fresh water is plentiful, air cooling of some processes is more economical than conventional water cooling. These include a crude and vacuum unit, a delayed coker, a catalytic cracker, a hydrogenation unit, a catalytic reformer, a catalytic polymerization plant, and treating plants. It was found that operating costs of air cooling are much lower than operating costs associated with water cooling.

Major Nuclear Power Development Goal. The consolidation of fuel recovery processes should be a major goal in the process development of nuclear power. Although the success of nuclear reactors generally is measured in terms of reactor behavior, economical nuclear power is dependent on additional steps in the fuel cycle, such as fuel fabrication and spent fuel recovery. A universal plant could probably handle many enriched as well as natural uranium-containing fuels at throughputs that should prove economical. Simplified and improved storage of waste will be beneficial to the universal process concept, thus resulting in a multipurpose recovery plant.

Professional Contributions Awards. The Professional Progress Award was made to W. K. Davis, the William H. Walker Award was given to Dr. R. L. Pigford, the Junior Award was presented to G. L. Houghton and R. D. Vaughn. The 1958 Student Problem Contest awards were made to Fred Stalkum (first prize), T. F. Rogers (second prize), and D. E. Jost (third prize).

Major Advance in Tubes—The Cold Cathode Principle

A radically new cool-running radio tube, which glows blue instead of red and uses less than $\frac{1}{10}$ the power of a standard tube, was recently unveiled by the Department of the Army. Developed jointly by the U. S. Army Signal Corps and Tung-Sol Electric Inc., the new "cold cathode" tube operates on an entirely new principle discovered by Dr. Dietrich Dobieschek of the U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J.

Early reliability tests indicate the tube may well outlast any equipment in which it is used. This means future radios and television sets equipped with cold cathode tubes may rarely if ever require tube replacement. The cold cathode principle is believed adaptable to almost all types of electron tubes, including television screens, giant radar and transmitting

tubes, as well as nearly all general-purpose radio tubes. Miniature and subminiature tubes, which could rival the transistor in size, are also feasible.

It could also create a revolution in tube design by making possible the first reliable "secondary emission multiplier"—potentially the world's highest gain amplifier tube. The device would allow design of simplified miniature circuits, more efficient than today's bulkier units. Until now, this type of tube has always failed because the hot cathode contaminated other elements in the glass envelope. By eliminating the hot cathode, the new tube solves this problem.

Ordinary tubes have always required a hot cathode element to generate needed electrons. But this heating takes a large per cent of the power and forces the use of more complicated circuits or extra batteries. In the new tube, the hot element is replaced by a cold cathode—a tiny nickel cylinder specially coated with porous magnesium oxide. Instead of heat, a high-voltage field causes the electron flow, which in turn produces the tube's characteristic phosphorescent blue glow.

This reaction requires a barely perceptible amount of electricity. A cold cathode tube can idle on 5 microwatts, a tremendous saving over standard tubes. Future designs should be even more efficient.

The new tube springs to life as soon as it is turned on, whereas an ordinary tube requires several seconds for warm-up.

The Army sees the discovery as leading to even smaller, faster-acting walkie-talkies, and simplified design of other communications gear where the heat generated by conventional tubes poses serious problems.

The new tube is extremely resistant to heat and atomic radiation, important in military equipment which must withstand exposure to a nuclear blast or the searing heat of a missile nose-cone.

10,000 Megacycle Sound Waves Created

The "highest-pitch sound" ever reported has been achieved by scientists who believe their accomplishment will open the way for new discoveries in solid-state research.

"Sound" waves with a frequency of 10,000 megacycles (10 billion cycles per second) have been produced by Dr. E. H. Jacobsen of the General Electric (GE) Research Laboratory, Schenectady, N. Y. This frequency is almost one million times greater than the highest-pitch sound the human ear can hear.

Lower pitched ultrasonics have been used widely in recent years for such special industrial jobs as cleaning metal parts and inspecting huge castings. The new ultrasonic frequencies will find their first applications in the laboratory, according to Dr. Guy Suits, GE vice-president and director of research. "One of the powerful techniques of solid-state research is to study materials by poking them, probing them, and shaking them—and observing how they react. Now we have one of the most effective methods yet for 'shaking-up' the atoms in solids," Dr. Suits said.

It is expected that the extremely high frequency vibrations will be used initially to investigate phenomena such as the energy levels of atoms and the interactions of electron spins in a crystal lattice.

Dr. J. H. Hollomon, manager of the Metallurgy and Ceramics Research Department in which the ultrasonic studies have been conducted stated that in the past, new research tools of this sort have always opened new vistas for exploration and discovery beyond those seen at the moment. Many important uses are seen in the study of solids, but science and technology will probably feel the greatest impact of this achievement through discoveries yet to be made with it.

Dr. Jacobsen created the 10,000 megacycle sound waves by combining techniques used in the propagation of microwave electromagnetic radiation with those of conventional ultrasonics. He applies microwave pulses to a quartz crystal in a specially designed cavity-resonator device.

The crystal is kept at temperatures as low as 2 degrees Kelvin (—456 F). The low temperatures assist in keeping the ultrasonic vibrations from "degenerating" into vibrations associated with the heat content of the material.

This unusual type of "heat barrier" is one of the biggest problems in achieving higher and higher frequencies, it was stated.

Any explanation of the new ultrasonics requires an understanding of the differences between "sound" waves and "electromagnetic" waves.

HIGHEST-PITCH SOUND, "sound" waves with a frequency of 10,000 megacycles (10 billion cycles per second), is almost one million times greater than the highest-pitch sound the human ear can hear. The ultrasonic frequencies are expected to find their first applications in solid-state research. Dr. E. H. Jacobsen, who produced the "sound," adjusts the wave guides that direct microwave pulses at quartz crystal. Held at temperatures close to absolute zero in a Dewar flask (shiny vertical cylinder visible at center of picture), the crystal is cooled by liquid helium. Plastic bag floating near ceiling is used to collect helium (currently in short supply) that has boiled off in gas form. It is then liquefied again and re-used.

"Sound" waves involve the mechanical motion of atoms. (A strict definition of "sound" limits it to the low frequencies—30 to 15,000 cycles per second—that can be heard by the human ear. However, ultrasonics is, physically if not physiologically, the same phenomenon.)

"Electromagnetic" waves are traveling disturbances in space (cosmic rays, gamma rays, X rays, ultraviolet, visible light, infrared, radar-television-radio waves, etc.).

Sound waves of all frequencies can be transmitted into solids; many of these same solids resist penetration by waves in certain parts of the electromagnetic spectrum. Thus, the new ultrasonics will help fill the gap in solid-state investigative techniques caused by the fact that many metals and other solids reflect electromagnetic microwave radiation much as a mirror reflects light.

Electromagnetic frequencies in the 10,000 megacycle range are used for microwave radar (wavelengths in the centimeter range). An ultrasonic frequency of 10,000 megacycles will be of varying wavelength because the speed of sound is different in different materials. Inasmuch as even the highest speeds of sound are far below the 186,000 miles per second of electromagnetic radiation, the ultrasonic wavelengths are extremely short. The waves produced in low-temperature quartz are approximately a ten-thousandth of a centimeter.

Because the new ultrasonic waves are far above audible limits, "musical" descriptions are hardly appropriate. Nevertheless, the new sound—if it could be heard—would be 20 octaves above high C.

Applications of Peltier Cooling Effect

Group Sponsors Research on Thermoelectric Cooling. Research on materials and techniques required for thermoelectric-cooling devices has just been started at Battelle Memorial Institute, Columbus, Ohio. Initially, the 2-year program is being sponsored by 16 American industrial firms interested in research basic to application of the Peltier cooling effect.

The basic objective of the study is the preparation of new compounds and investigation of their resistivity, thermal conductivity, and thermoelectric power. Materials to be studied will be compounds chosen from the following systems: Cu, Ag, Au—S, Se, Te; Zn, Cd, Hg—As, Sb, Bi; alkaline-earth metals—Ge, Sn, Pb, As, Sb, Bi; and alkali metals—Ge, Sn, Pb, As, Sb, Bi. In addition, alloys of these compounds will also be studied.

Dr. E. H. Lougher, who will co-ordinate the research program, pointed out that the Battelle study will concentrate on the thermoelectric properties of materials which have thus far received relatively little attention for thermoelectric devices. Materials that have already been investigated extensively, such as bismuth telluride, are not included in the present study, he said.

The Battelle chemist said that the research is the result of "what was, in effect, a general invitation from Battelle

for industry's support of much-needed research in this area." He indicated that it is anticipated that additional companies will join in the sponsorship of this research, as the program progresses.

Companies sponsoring the research initially include: American Motors Corporation; Carrier Corporation; Chrysler Corporation; Fedders Corporation; General Motors Corporation; Hamilton Standard Division, United Aircraft Corporation; Lockheed Aircraft Corporation; The Martin Company; Monsanto Chemical Company; National Carbon Company, Division of Union Carbide Corporation; Ranco Incorporated; Tecumseh Products Company; Texas Instruments Incorporated; Westinghouse Electric Corporation; and Whirlpool Corporation.

Specialists from both Battelle's Solid State Devices Division and Physical Chemistry Division will be called upon to assist in the thermoelectric-cooling research program. They have been engaged in research on thermoelectric materials, including lead telluride and its alloys, for the past eight years. For 3 years, they have also been conducting research on bismuth telluride and related compounds.

Full-Scale "Hot–Cold–Light" Panel. A full-scale wall panel that promises to light tomorrow's home while also heating or cooling it has been unveiled by Westinghouse Electric Corporation. The "hot-cold-light" panel responds to a set of dials which can change its temperature from a low of 55 F to a high of 120 F, and vary the intensity and color range of the light source.

The versatility of this "hot–cold–light" panel results from combining into a single operating unit two of man's latest technological advances: thermoelectric heating and cooling, and electroluminescent lighting.

The demonstration panel screen provides a range of hues from blue to blue-green to green but other color combinations, including the entire spectrum, are possible.

Controls for the entire panel consist of four dials: one to change color combinations; a second to vary the light intensity; a third to select either heating or cooling; and, finally, a highly sensitive thermostat for automatic temperature control.

FULL-SCALE panel developed by Westinghouse promises to light as well as to heat and cool homes of the future. Panel combines latest advancements in electroluminescence for lighting and thermoelectric heating and cooling. Anodized aluminum "mobiles" superimposed upon electroluminescent (Rayescent) screen provide surface area on panel for heating and cooling. Light can be varied in shadings from blue to blue-green to green.

The thermoelectric effect is accomplished without the aid of any moving parts such as are present in the conventional refrigeration. Thermoelectric refrigeration produces cooling in special solid materials directly from the flow of an electric current. Heating occurs when the direction of current is reversed.

Electroluminescent lighting is produced by exciting a phosphor coating with an alternating current. This phosphor coating is sandwiched in a panel no thicker than a pane of window glass. The principle of electroluminescence is used in Rayescent lamps now being produced by Westinghouse and available for applications other than general lighting. This new panel holds promise of bringing additional comfort and beauty to the home of the future.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, *Electrical Engineering* reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

Unity Functional Plan

To the Editor:

The Intersociety Relations Committee of AIEE is to be congratulated on its report, "Position on Organization of the Engineering Profession," published in the February issue of *Electrical Engineering*. The Functional Plan as outlined in this report sheds real light on the much booted-about question of a unity organization for the engineering profession. Some of this information has been given before in *Electrical Engineering* but this report sums it up and gives a chart that is worth more than a thousand words. The chart tells even the mildly interested engineer that this plan recommends that he belong to the outstanding professional organization (NSPE) as well as to one of the technical societies. It also shows that EJC and ECPD may continue their valuable work as Councils but not as direct representatives of members of the technical societies in such matters as state registration, employment practices, and economic position. Such matters are common to all engineers and must be handled by an organization that has direct dues-paying members and has direct contact with its membership. As important as EJC has become, it can never actually represent individual members by working back through many technical societies. Such an operation is simply too slow and clumsy.

It does not appear possible to me that there can ever be one big over-all "Unity Organization" of engineers to handle both technical and professional matters such as the medical profession has in the American Medical Association. The kinds of engineering are too many. The medics all deal with one piece of machinery, the human body. Engineers deal with hundreds of thousands of different machines and human situations.

Back in the 1850's the American Society of Civil Engineers was actually a unity organization for all civilian engineers. Hence its name. But look at us today. There are over 70 national engineering societies. The Functional Plan outlined in the report is the reasonable and common sense answer to the problem. It is gratifying to note that AIEE has been a pioneer and large motivating force in evolving a satisfactory solution. Presidents Hull and Fairman of about a decade ago deserve much credit for pioneering effort toward formulating a plan suitable to AIEE members and to members of the profession as a whole.

I can envision official acceptance of the plan by most of the technical engineering societies, but whether or not they accept it, its success depends upon realization of its importance by individual engineers.

The public does not yet generally recognize engineering as a profession. It pains me deeply when radio announcers, public speakers, and writers enumerate professionals as doctors, lawyers, teachers, and clergymen, but do not mention engineers.

I should like to take this opportunity to predict an accelerating support of this plan by engineers throughout the country accompanied by marked advances both in the dignity of the profession and the effectiveness of the individuals that comprise it.

CLARENCE A. ATWELL (AM '41, M '43, F '50, Member for Life)

Engineer—or Technician?

To the Editor:

I would like to express some facts and opinions which might be of interest to the Institute.

Giving this story proper background, I must relate some basic facts about my-

self. I served the USAF four years as an electronics technician and instructor. Upon completing my tour of duty, I had the opportunity of accepting several handsome offers to become an electronics technician or a field representative. However, I chose to go to college (LSU) to earn a BSEE. During the years at LSU, my wife and I lived in a broken down shack and existed under minimum conditions. We did not mind this as the reward would be more than adequate.

Presently, I hold the title of "Field Engineer" with a leading electronics firm. A few days ago, I read a copy of the February issue of the Marine magazine *Leatherneck* wherein was a story on the project to which I am assigned. Together with three other Field Engineers (engineers who are engineers without having engineering degrees), my name was listed with the title "Field Service Technician."

True enough, this seems to be a fine point, but four years ago I was a qualified field service technician and chose to go to college in order that I would become a graduate engineer. Now, those years of sweat and toil seem unaccountable for, because I am still what I was before college, professionally speaking.

If the work by a doctor of medicine were published and the author were named a "Medical Technician," the doctor would surely be offended. I cannot understand why it should be so different for the engineer.

I would like to summarize with the following question, to which an answer must eventually evolve. Doctors and lawyers must have certain qualifications to be termed as such. Why then, should it be possible for people with the least experience in electronics to call themselves engineers and be accepted as such by both industry and public?

GUNTHER KARGER (AM '58)

High Residential Voltage

To the Editor:

I wish to refer to H. H. Watson's paper on "Higher Residential Voltages, Safety Considerations," in the February 1959 issue of *Electrical Engineering*. In this article, as in former investigations of this kind, emphasis has always been put on the increased hazard by employing higher voltages in single- and multi-family residences. All these considerations do not take one point into consideration, namely that by doubling the voltage in residential dwellings one other hazardous condition could be eliminated which represents at present a big problem in many existing dwellings. This existing hazard is the state of overloading of the present wiring because of the additional loads which have been added in many residences since the time when the original wiring had been installed.

The writer who hails from Berlin, Germany, experienced the same kind of problem about 35 years ago when the then existing 127/220-volt 3-phase 4-wire system of Berlin got overloaded and the power company decided to change over to a 220/380-volt 3-phase 4-wire distribution system, this way about doubling the distribution capacity. The change-over was put into effect at the expense of the power company, proceeding in such a manner that the power company installed the required new transformers and also replaced customer's 125-volt appliances by 220-volt appliances (or rewiring them for the higher voltage where applicable). In the end, this procedure proved to be less expensive to the power company than increasing the distribution capacity by installing additional copper. And the change-over was accepted by the customer without any ill feeling since the customer had the advantage of having more electric power at his disposal, without expense, interruption of service, or inconvenience.

On the other hand, I never heard anything about an increase of accidents after the change-over to the higher voltage.

Very truly yours,

DR. HENRY M. CANN (AM '45, M '52)

(Application Engineer, Zenith Engineering Corporation, Newark, N. J.)

NEW BOOKS

The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.

ADVANCES IN ELECTRONICS AND ELECTRON PHYSICS, 10th volume. Edited by L. Marton and Claire Marton. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y., 1958. 320 pages, 6¼ by 9¼ inches, bound. $10. This book reviews current research in the following fields: nonuniform d-c electron flow in magnetically focused cylindrical beams, defects in diamond-type semiconductor crystals, microwave optics, computer logical organization, tube reliability, and developments in the cathode-ray oscilloscope.

AMERICAN POWER CONFERENCE PROCEEDINGS, Volume XX. Published by Illinois Institute of Technology, Technology Center, 16, Ill., 1958. 748 pages, 6¼ by 9¼ inches, bound. $8. Papers dealing with varied aspects of the generation, transmission, and utilization of power are presented. Among the topics discussed are steam and gas turbines, and water technology; hydroelectric power; nuclear power development; industrial plants; central stations; transformers; extrahigh-voltage systems; distribution equipment; fuels; heating, ventilation, and air conditioning; and computers and network analyzers.

BRITISH ELECTRICAL POWER CONVENTION PROCEEDINGS, 1958. Published by The Convention, London, England, 1958. 436 pages, 5¾ by 8½ inches, bound. No price given. Papers and discussions are included on the development of nuclear energy for electricity supply in Great Britain and in other parts of the world, British assistance in the development of electrical power outside of Britain, the British position in world hydroelectric power, and the development of the electrically equipped kitchen.

ELECTRICITY IN AIRCRAFT. By F. G. Spreadbury. The MacMillan Company, 60 Fifth Ave., New York 11, N. Y., 1959. 342 pages, 5¾ by 8¼ inches, bound. $8. This text covers systems of generation in aircraft, both d-c and a-c; rotary converters and inverters; aircraft storage batteries; switchgear and cables; motors and their applications; general utility equipment in aircraft such as lighting, food heating, and windscreen de-icing; and testing and test equipment. The subject of ignition is treated only in relation to its application to turbine starting.

ELECTRONIC DIGITAL COMPUTERS. By F. L. Alt. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y., 1958. 336 pages, 6¼ by 9¼ inches, bound. $10. The book is intended for physicists, chemists, engineers, and others in similar fields who require the solution of computational problems by means of digital computing machines. The author deals mainly with the functioning, rather than the design, of computers, although some of the underlying physical principles are indicated. Following an introduction, the book covers automatic digital computers, coding and programming, problem analysis, and matching problems and machines.

ELECTRONICS OF MICROWAVE TUBES. By W. J. Kleen; translated by P. A. Lindsay and others. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y., 1958. 349 pages, 6¼ by 9¼ inches, bound. $9. The effects governing the operation of microwave tubes now used in telecommunications are explained both qualitatively and quantitatively. Aspects studied include electron motion in static fields, currents in microwave tubes, exchange of power between electron streams and periodic electric fields, velocity modulation in stationary fields, use of stationary fields for extracting power from the beam, phase selection, modulation of electron streams by traveling waves in the absence of static transverse fields, free space-charge waves, and interaction between electron beams and traveling waves in crossed electric and magnetic fields.

ELEKTRONENBEUGUNG. By Ernst Bauer. Verlag Moderne Industrie, Munich, West Germany, 1958. 233 pages, 6¼ by 8½ inches, bound. 32 DM. Part I of this book on electron diffraction deals with theory. Part II covers the experimental aspects: details of equipment, preparation and procedures, and interpretation. Part III discusses applications in the following industries: metallurgical, metal-working, chemical, electrical, and optical. An extensive bibliography is included.

ELEMENTARY MATHEMATICAL PROGRAMMING. By R. W. Metzger. John Wiley and Sons, Inc., 440 Fourth Ave., New York 3, N. Y., 1958. 246 pages, 6¼ by 9¼ inches, bound. $5.95. Intended as an intermediate approach, the subject is presented in relatively nonmathematical terms. Following a general treatment of the distribution, simplex, and approximation methods, the complete solution and analysis of two typical industrial problems—manufacturing and blending—is presented. The applicability of high-speed computers for solving problems is then discussed, and available computer programs are indicated which will accomplish the solution of mathematical programming problems. The remainder of the book illustrates the details of various problems solved by programming.

THE ENGINEER AND PROFESSIONAL MANAGEMENT. By Harry Rubey. Lucas Brothers, Missouri Store Co., 909 Lowry St., Columbia, Mo., 1958. 299 pages, 9¼ by 11¼ inches, ring binding. No price given. An introduction to management functions for the engineer beginning his career, the book is divided into two parts. The first deals with such nonengineering functions as promotion, finance, professional management, organization, marketing, advertising, purchasing, and public relations. The second part deals with such semi-engineering functions as managerial accounting and auditing, cost accounting and statistical control, estimating, valuation or appraisal, engineering economy, and industrial technologic research.

FAST REACTIONS IN SOLIDS. By F. P. Bowden and A. D. Yoffe. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y., 1958. 164 pages, 6¼ by 10 inches, bound. $7. The book deals with recent experimental investigations into the mechanism by which an explosion can be initiated in a solid, and in particular with the mechanism by which a crystal can decompose when subjected to heat, light, shock, or nuclear radiation. High-resolution electron microscopy combined with electron

diffraction is used to investigate the early stage of decomposition, and high-speed photography and fast electronic methods are employed to follow the rapid reaction. An important application of the subject matter is the accurate control of the burning of explosive materials.

GLOVE BOXES AND SHIELDED CELLS FOR HANDLING RADIOACTIVE MATERIALS. Edited by G. N. Walton. Academic Press Inc., 111 Fifth Ave., New York 3, N. Y., 1958. 515 pages, 6¼ by 10 inches, bound. $16.80. Papers dealing with radiation shielding, based mainly on British practice, are given. Part one is concerned with unshielded boxes and discusses safety, general design and manufacture, constructional materials, decontamination, layout in laboratories, provision of inert atmospheres, handling of polonium, operations with gaseous materials, and large scale operations. Part two deals with shielded cells, and discusses shielding calculations, viewing and handling equipment, design of shielded cells as well as operations on beta-ray emitters, plutonium, multicurie cesium sources, and irradiated fissile materials. These papers comprise the proceedings of a symposium held at Harwell, England, in 1957.

GROWTH AND PERFECTION OF CRYSTALS. Edited by R. H. Doremus and others. John Wiley and Sons, 440 Fourth Ave., New York 16, N. Y., 1958. 609 pages, 8¾ by 11½ inches, bound. $12.50. Reports of an international conference held at Cooperstown, N. Y., in 1958, on crystal phenomena, polymer crystallization, and crystallization of simpler molecules are presented. Organic, inorganic, and polymeric substances are investigated from the standpoint of crystal perfection, formation and structure of whiskers, presence of dislocations, and the mechanism of crystal growth from the melt, solution, and vapor. Several papers emphasize the differences and similarities between polymer and ordinary crystallization.

HAND IN HAND. By The Hand in Hand Book Committee. Gordon and Co., 22 Harvard Ave., West Medford, Mass., 1958. 337 pages, 6¼ by 9¼ inches, bound. $10. Following a brief survey of the co-operative engineering education program from its inception to the present, approximately three quarters of this book is devoted to biographical sketches of those engineers who have participated in this program.

NATIONAL CONFERENCE ON THE ADMINISTRATION OF RESEARCH, PROCEEDINGS. Published by the Pennsylvania State University Press, University Park, Pa., 1958. 163 pages, 8½ by 10¾ inches, paper. $4.50. These proceedings of the 11th Conference, held in 1957, deal with the management of scientific and engineering research and with the utilization and career planning of technically trained personnel. Beginning with discussions on creativity, the book continues with the attitudes and motivations of scientists and engineers toward their jobs; measurement of research accomplishment; the size of research and engineering teams; administrative attitudes toward basic research; and studies on basic research in the United States, Europe, and the Soviet Union.

NEW FABRICATION TECHNIQUES. Published by American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio, 1958. 62 pages, 8½ by 11 inches, paper. $2.95. This is a compilation of papers presented at the Southwestern Metal Congress in May 1958. Papers included deal with the theory and application of electrodischarge machining, high-speed cutting, the chemical milling process, designing in aluminum for the impact process, forming at elevated temperatures, adhesive bonding of primary aircraft structure, and a new concept of weld metal for high-strength fabrication.

NUMERICAL METHODS. By A. D. Booth. Second edition, Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y., 1957. 195 pages, 5¾ by 8¾ inches, bound. $6.50. The book is intended to provide an understanding of the basic principles upon which numerical analysis rests with a view to applying those principles to computers. Covered are tabulations and differences, interpolation, numerical differentiation and integration, summation of series, solution of ordinary differential equations, simultaneous linear equations, partial differential equations, nonlinear algebraic equations, approximating functions, Fourier synthesis and analysis, and integral equations.

ORDINARY DIFFERENTIAL EQUATIONS. By Wilfred Kaplan. Addison-Wesley Publishing Company, Inc., Reading, Mass., 1958. 534 pages, 6¼ by 9¼ inches, bound. $8.50. Although this book may be used as a general text, the author emphasizes the relationship of differential equations to their applications in physics and engineering, especially those aspects which are important for servomechanisms and differential equations. The author follows an approach used in modern systems analysis, based on the concepts of "input" and "output." Problems and solutions are given throughout the text.

OPERATIONS RESEARCH FOR INDUSTRIAL MANAGEMENT. By D. N. Chorafas. Reinhold Publishing Corporation, 430 Park Ave., New York 22, N. Y., 1958. 303 pages, 6¼ by 9¼ inches, bound. $8.75. Recently developed operations research techniques used for executive decision-making with emphasis on simulation studies are presented. The application of operations research methods is considered in relation to financial allocation, transportation problems, inventory control, and production setups. Descriptions are also given for game theory, linear programming, flow techniques, and matrix algebra. The use of electronic computers in relation to operations research is discussed.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by AIEE members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 W. 39 St., New York 18, N. Y.

PHOTOMETRY. By J. W. T. Walsh. Third edition. The Macmillan Company, 60 Fifth Ave., New York 11, N. Y., 1958. 544 pages, 6 by 9½ inches, bound. $12.75. This edition contains corrections to material contained in the previous edition as well as improvements in the treatment of certain sections. References have also been brought up to date. Included are chapters on radiation; photoelectric cells; measurement of luminous intensity; light distribution and total flux measurement; heterochromatic photometry; colorimetry; spectrophotometry; illumination and luminance; measurement of reflection, transmission, and absorption factors; and stellar photometry.

REGLER UND REGELUNGSVERFAHREN DER NACHRICHTENTECHNIK. Edited by G. Hässler and E. Hölzler. R. Oldenbourg, Munich, West Germany, 1958. 118 pages, 6¼ by 9½ inches, bound. 15 DM. This group of papers from a symposium on automatic controls in telecommunication includes the following topics: theory of automatic control systems, level control in long-distance telecommunication, control of power supply units, arrangement in series of controllers of the same kind, control of modulating systems, and control systems with digital computers.

ROCKETRY AND SPACE EXPLORATION. By A. G. Haley, D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N. J., 1958. 334 pages, 7 by 10¼ inches, bound. $6.75. Following a brief, nontechnical explanation of the operation of rockets, a complete history of their development is given. The book begins with the origins of rocketry in the 1930's and continues with the Axis war rockets of World War II, and such postwar developments as the Atlas, Titan, Thor, Nike, *X-15*, Sputniks, Vanguard, and Explorers. Concluding chapters deal with the efforts made toward international co-operation in astronautics, and with the work of such societies as the American Rocket Society and the British Interplanetary Society.

STAUANLAGEN UND WASSERKRAFTWERKE. I. Teil: Talsperren. By Heinrich Press. Second edition. Wilhelm Ernst & Sohn, Berlin, West Germany, 1958. 395 pages, 7¼ by 9¾ inches, bound. 54 DM. Part I of a 3-volume set on hydroelectric power plants, this enlarged volume gives a concise but comprehensive description and analysis of the various types of modern concrete gravity, arch, and earth dams, with a wealth of illustrative sketches and photographs from existing installations. Auxiliary structures and equipment are also shown, and there is a bibliography of over 1,200 items.

TRANSPORT PROCESSES IN STATISTICAL MECHANICS. Edited by I. Prigogine. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y., 1958. 436 pages, 6¼ by 9¼ inches, bound. $10. Among those aspects dealt with in the present volume are statistical mechanics and the Boltzman equation, gravitational forces and dynamic friction, statistical mechanics of the steady state, diffusion in velocity space and transport phenomena, a mathematical treatment of diffusion in gas mixtures, the theory of transport phenomena in solids, quantum statistics, the definition of entropy in magnetic resonance, cyclic processes in irreversible thermodynamics, thermal conductivity in gases, and the diffusion of tracers through solids. This volume constitutes the proceedings of an international symposium held in Brussels, Belgium, in 1956.

UNDERGROUND LIGHTING IN MINES, SHAFTS AND TUNNELS. By A. Roberts. The Macmillan Company, 60 Fifth Ave., New York 11, N. Y., 1958. 292 pages, 7½ by 10 inches, bound. $12.75. The author begins with the definitions and units now used in lighting and with a description of the elements of photometry essential to correct lighting design. This is followed by the application of good lighting technique to particular problems which include mine, roadway, and surface lighting; lighting in explosive atmospheres underground; and tunnel and subway lighting. The concluding section deals with various kinds of lighting equipment and appliances as well as their installation, maintenance, and use.

URANIUM AND THORIUM. By L. Grainger. Pitman Publishing Company, 2 W. 45th St., New York 36, N. Y., 1958. 204 pages, 5½ by 8¾ inches, bound. $6. This study is of interest to those dealing with fissionable materials. It summarizes and attempts to make clear some of the recent material published on the subject of uranium and thorium. Aspects covered are occurrence and extraction, chemical and physical properties, health hazards, and use as nuclear fuels. A concluding section discusses current practice and the future possibilities of fuel elements.

TECHNICAL LITERATURE

The following recently issued technical literature may be of interest to readers of *Electrical Engineering*. All inquiries should be addressed to the issuers.

CIVILIAN NUCLEAR POWER. The Ad Hoc Committee on Reactor Programs and Policy of the U. S. Atomic Energy Commission (AEC) was organized in October 1958. It submitted its report to the AEC in January 1959. The report is under study by the AEC. In view of the wide public interest in this subject, the Commission considers public release of the report, TI-57 (B-4), appropriate. It is available from U. S. AEC, Washington 25, D. C.

KEMPE'S ENGINEERS YEAR-BOOK, 1959, 64th edition. The 79 chapters of the present edition cover practically every branch of engineering. The whole of the subject matter has been carefully examined and there are a great many alterations and additions which bring the information up to date. In this edition, the following chapters have been re-

written: "Flow Metering and Mechanical Testing," "Refrigeration," and "Paints and Varnishes." The necessary changes made in the index, which contains more than 17,000 entries, provide easy access to the contents. Most chapters include a bibliography giving a list of standard works on the subject. A number of new illustrations have been added. The yearbook may be ordered from Morgan Brothers (Publishers) Limited, 28 Essex St., Strand, London, W.C. 2, England, at $12 including return postage charges.

THE PRACTICAL DICTIONARY OF ELECTRICITY AND ELECTRONICS. By R. L. Oldfield, the dictionary brings together the terms most often used today in electricity and electronics, providing a basic trade vocabulary. Emphasis was centered upon the practical needs of men concerned with the service, operation, and use of electrical and electronic equipment, as well as those engaged in the selling and distribution of such apparatus. The book also includes a 38-page handbook section containing the most-needed formulas, tables, symbols, and circuit diagrams connected with the field. Published by the American Technical Society, 848 E. 55th St., Chicago 37, Ill., the dictionary is priced at $5.95.

PROCEEDINGS OF THE 4TH NATIONAL CONFERENCE ON TUBE TECHNIQUES, September 1958. The 41 papers included were edited for publication by David Slater, secretary, and the editorial committee of the Working Group on Tube Techniques of the Advisory Group on Electron Tubes. U.S. Office of the Assistant Secretary of Defense, Research and Engineering. Dealing with various problems over the entire field of modern electron tube techniques, the papers include special material on the problems of gettering; vacuum methods; sealing for ceramics, metals, and glasses; structures; methods; microwave tube techniques; cathodes and cathode materials; emission phenomena; and cathode interface. The 192-page paperbound volume may be obtained from New York University Press, 32 Washington Place, New York 3, N.Y., at $5.

LA PILE EL. 3. Published by the Atomic Energy Commission of France, this work contains a preface by Francis Perrin, High Commissioner of Atomic Energy, under whose direction the pile was installed. Jacques Robert, assistant director of the Atomic Pile Research Department of the French Atomic Energy Commission, has written an introduction to the book, which was compiled and edited under the direction of Jean Hainzelin, service chief of Atomic Studies of Chantiers de l'Atlantique. The contributing authors themselves worked on the construction of this reactor. Detailed descriptions of all the components that make up the El. 3 facility, which has a high thermal flux (10^{14} neutrons per square centimeter per second) are given and discussions of the technological problems encountered and resolved for this type of reactor are included. There are 15 technical subjects covered in the appendix, all fully illustrated, accenting truly representative aspects of El. 3, such as: rupture detections in sheaths, rapid measurements of temperatures in the honeycomb structure, and observations of rod activity. Marking an important step in the development of atomic equipment, this book will be a valuable addition to libraries of laboratories and industrial research institutions, and of great help to scientists in the field of research or atomic physics. It may be ordered from Presses Universitaires de France, 108 Boulevard Saint-Germain, Paris 6, France, at 5.200 French francs.

FEDERAL AVIATION AGENCY RELEASE. Climb corridors to assist jet fighters flying an air defense scramble are being revised by the FAA to handle the following five types of jet interceptors: *F-101, F-104, F-106, F-4D,* as well as the *F-102* jet fighter for which the corridors were established in 1958. A listing of the 10 corridors presently designated and in use, as well as those 30 additional corridors planned, is available as release FAA-59-#13 from FAA, Washington 25, D. C.

NATIONAL LIBRARY WEEK. A nationwide campaign to promote reading will be climaxed by National Library Week, April 12-18, 1959. The aim of the program, sponsored by the American Library Association and National Book Committee, Inc., is to promote more reading at all age and income levels, to increase reading by confirmed readers, and to find new readers. In explaining its aims, the Steering Committee said, in its statement: "We want to remind Americans what the printed word means to free men in a free society . . . We are certain that the Founding Fathers were right in their conviction that the future of this country hinges on the enlightenment of its citizens, for through his own knowledge and action, each man helps to guide the direction of the nation." More detailed information on the celebration may be obtained by writing National Library Week, 24 W. 40 St., New York 18, N. Y.

TECHNICAL TRANSLATIONS. Published twice a month by the Office of Technical Services (OTS), this new abstract journal provides a central source of information in the United States on translated technical literature available to science and industry. It lists and abstracts translations available from OTS, the Special Libraries Association (SLA) Translation Center, co-operating foreign governments, educational institutions, and private sources. Published in co-operation with the SLA, it has incorporated that organization's periodical, *Translation Monthly.* Subscription rates are $12 a year ($4 additional for foreign mailing); single copies are 60¢. The journal may be ordered from U. S. Department of Commerce, Office of Technical Services, Washington 25, D. C.

NATIONAL SCIENCE FOUNDATION, 8TH ANNUAL REPORT, 1958. This report for the fiscal year ending June 30, 1958, begins with a foreword by Chairman Detlev Bronk, and a statement from Director Alan Waterman. The report is divided into three major sections: "The Year of the Earth Satellites—The Status of Science and Education in the United States," "A Photographic Sampling of Foundation-Supported Activities," and "Program Activities of the National Science Foundation." Included in the latter is a section on the International Geophysical Year. There are eight appendixes dealing with staff, committees, and advisory panels; financial statistics; grants and fellowships; and publications. The report may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Price is $1.

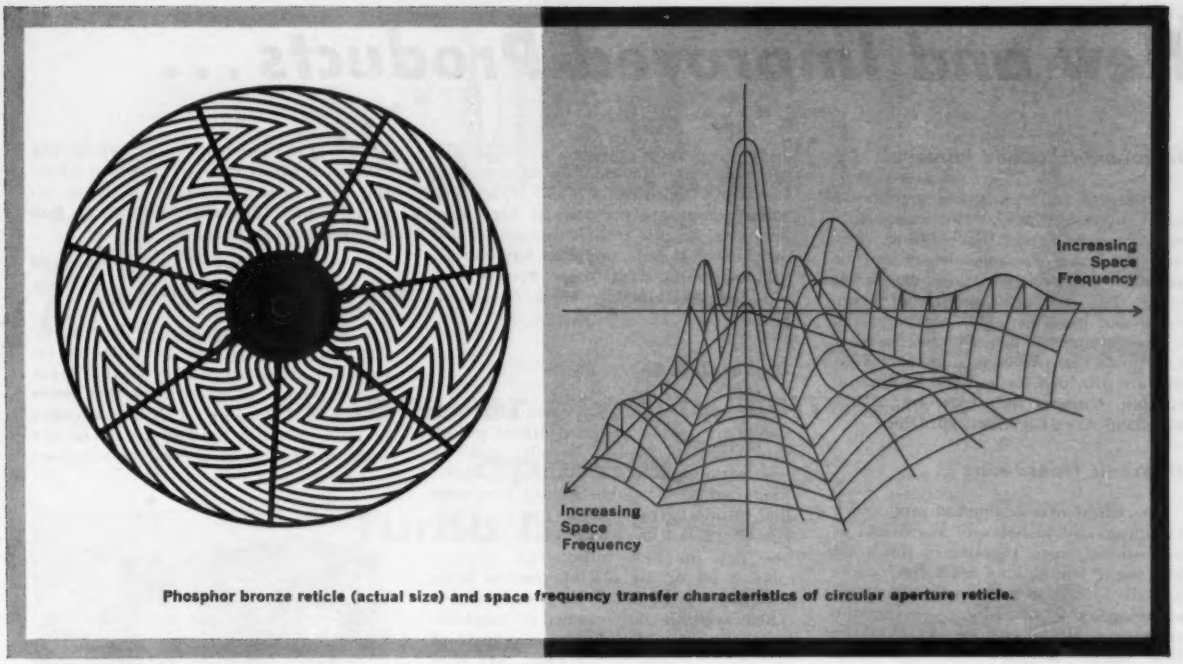
ASA STANDARDS. The "American Standard Requirements, Terminology, and Test Code for Distribution, Power, and Regulating Transformers, and Reactors other than Current-Limiting Reactors" has been revised and republished in six separate volumes. The total price of all six volumes, C57.12, is $10.40; individual volumes may be ordered. Other recently approved and published ASA standards include: a revision of "American Standard Schedule of Preferred Ratings for Alternating- and Direct-Current Low-Voltage Air Circuit Breakers," C37.16-1958, 40¢; and the second edition of the International Electrotechnical Vocabulary 50 (45), "Lighting," $4, prepared by the International Electrotechnical Commission (IEC). Both the IEC publication and the ASA standards may be ordered from ASA, 70 E. 45 St., New York 17, N.Y.

TECHNICAL SOCIETIES GUIDE. Published by the Industrial Publicity Association (IPA), this second edition has been compiled to serve as reference for industrial publicists on the procedures for formal presentation of technical papers and preparation of related publicity for publication in the journals of technical societies. In addition to the presentation of individual requirements for 36 technical, industrial, and professional organizations, the guide contains an over-all discussion of manuscript requirements, oral presentation, visual aids, helpful devices for the speaker, preparation of manuscripts for reproduction, and reprints. The guide may be ordered from IPA, Technical Societies Committee, Room 1616, 41 E. 42nd St., New York 17, N. Y., at $3.

AEC RELEASES. The Atomic Energy Commission has announced the availability for loan and sale of 45 technical films used at the 2nd International Conference on the Peaceful Uses of Atomic Energy at Geneva, Switzerland, in September 1958. The 16-mm films, most of which are in color, cover major nuclear applications and research activities. A list of the films and the domestic AEC film libraries (Bulletin No. TI-67) may be obtained by writing Public Information Service, U. S. Atomic Energy Commission, Washington 25, D. C. Other recent releases from the AEC include: No. TI-68, "78 Patents Released for Public Use by U.S. Atomic Energy Commission"; No. TI-69, "AEC Transfers Contract Appeals Board Functions to Office of Hearing Examiner"; and No. TI-70, "AEC Announces Limited Deferred Payment Plan for Enriched Fuels for Foreign Power Reactors."

AN ESSAY ON THE APPLICATION OF MATHEMATICAL ANALYSIS TO THE THEORIES OF ELECTRICITY AND MAGNETISM. In March 1828, George Green published his Essay on Electricity and Magnetism in which he founded the mathematical theory of electrostatics and magnetostatics. Green published his work by subscription; the total number of copies is estimated to have been less than 100. Written in a lucid style, the Essay can still be read with great profit by the student of mathematical physics or theoretical electrotechnics. The present facsimile reproduction was made from an original copy, and was printed by offset in the format of the original. Printed in 1958 by Wezäta-Melins AB, Göteborg, Sweden, for Stig Ekelöf, Chalmers University of Technology, the book will be sent postage paid on remittance of $5 or the equivalent of Swedish kronor to Institute for Theoretical Electricity, Chalmers University of Technology, Göteborg S, Sweden.

STRENGTHENING AMERICAN SCIENCE. A report of the President's Science Advisory Committee, this 36-page pamphlet includes a statement by President Eisenhower. The role of the Federal Government is defined and its apparent influence in shaping the science and technology effort is stated. Problems and opportunities presented are outlined and responsibilities of the Federal Government listed. It further recommends that the United States "be both resourceful and wise in devising new means and in conceiving new institutions for carrying out the challenging jobs that lie ahead." The almost incredibly complex role of the Government in planning and management of this highly diversified research and development effort is pointed out. Needs for improvement in instrumenting the over-all effort are documented. The need for strengthening Government laboratories as well as the need to define over-all scientific and technical needs of a department are emphasized. Recommendations are listed at the end of the pamphlet available on request from the U.S. Government Printing Office, Washington, D.C.



Phosphor bronze reticle (actual size) and space frequency transfer characteristics of circular aperture reticle.

TARGET DISCRIMINATION IN INFRARED DETECTION SYSTEMS

The pioneering field of infrared detection offers many challenging opportunities to scientists and engineers at Ramo-Wooldridge for advanced studies in the solution of target discrimination problems. Research is continually under way at Ramo-Wooldridge in the integrating of infrared detection devices with the latest electronic systems techniques for enhanced target detection on the ground and in the air.

The phosphor bronze reticle, or image chopper, illustrated above was developed by Ramo-Wooldridge. It indicates a marked stride in space filtering discrimination concepts, and is used for target signal enhancement in guided missiles, anti-aircraft fire control and air collision warning applications.

The reticle is used in the focal plane of an infrared optical system and is rotated to chop the target image for the desired space filtering. It is also employed in time filtering, such as pulse length discrimination, or pulse bandwidth filtering.

Space filtering is critical to infrared systems, because of its ability to improve the detection of objects located in the midst of background interference. In a manner similar to that used in the modification of electronic waveforms by electrical filtering, space filtering enhances the two-dimensional space characteristics of a target. The size and features of the target are highlighted and the undesired background eliminated.

Scientists and engineers with backgrounds in infrared systems—or any of the other important areas of research and development listed below —are invited to inquire about current opportunities at Ramo-Wooldridge.

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Digital Indicator and Printer . . .

Designed for high accuracy and resolution indication, Model *176* permanently records weight, strain, temperature, pressure, and other variables which can be measured by sensitive bridge-type transducers. The unit gives continuous monitoring and permanent periodic recording of the variable in printed tape form at rates up to two readings per second. Controls are provided for run and calibration selection. **Gilmore Industries, Inc., 13015 Woodland Ave., Cleveland 20, Ohio.**

Ultrasonic Transducers . . .

A radical new design has produced a transducer said to be twice as efficient as conventional types. In place of the usual thin metal laminations built into stacks that are welded to a common plate, this magnetostrictive transducer spaces the laminations into a latticework across the plate. Each lamination then becomes a driving element resulting in an even distribution of power across the plate. **Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.**

Solid-State Thyratron Control . . .

Essentially a low-power high-speed magnetic amplifier, this device provides the necessary signal to control solid-state thyratron systems which, in turn, can drive inductive and resistive loads without complicated circuitry. The unit offers the advantage of proportioning and switching control and at the same time provides isolation of multiple logic inputs. Applications include static switching, temperature control, welding control, variable d-c and constant current supply, and pulse width modulation. **Magnetics, Inc., Butler, Pa.**

Magnetic Core Tester . . .

Developed for use by both production and design engineers, the *RK-100* tests tape wound cores, ferrite cores, and relays and monitors tolerances on core parameters, determines drive requirements, switching times, and voltage and disturbance output. Parameters are read on a scope to plot families of curves for determination of coercive force, volts per turn, and other data. **Arkay Engineering, Inc., 225 Santa Monica Blvd., Santa Monica, Calif.**

Printed Circuit Motor . . .

With the aid of printing techniques, the cylindrical wire windings of the conventional motor are replaced by flat disc-like coils. As a result the new motor is pancake shaped rather than cylindrical and is generally constructed so that only the light-weight printed circuit revolves. In addition to low armature costs, the light weight of the rotary printed circuit allows small instrument motors to reach full speed in a few thousandths of a second. Insulation difficulties are also eliminated, when motors are operated at high temperatures, because printed circuits formed on glass or ceramic supports have no insulation in the usual sense. **Printed Motors, Inc., 30 Rockefeller Plaza, New York, N. Y.**

Digital Decoder . . .

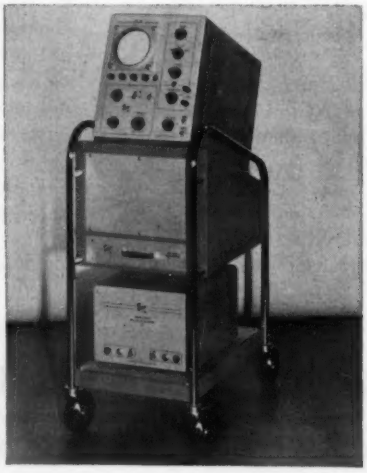
Set to respond to any one of 20 million combinations of coded digital pulses, this electromechanical decoder can be reset without tools in less than one minute. Energized by d-c pulses from a telephone dial or an electromechanical or electronic encoder, a notched circle wheel is driven one step for each pulse. The response code is set up by placing pins in holes near the rim of the 70-tooth code wheel. Their position and number in combination will cause the closure of a pair of electrical contacts. **Secode Corp., 555 Minnesota St., San Francisco 7, Calif.**

Multiswitch Indicator . . .

Rapid checking of temperatures at as many as 108 stations is made possible with this *9,000* series indicator. The basic instrument is a self-contained, null balance unit that requires only external sensing devices. With proper circuitry and the use of transducers, other variables such as speed, strain, and other quantities may be indicated. **Barber–Colman Co., Wheelco Instruments Division, Rockford, Ill.**

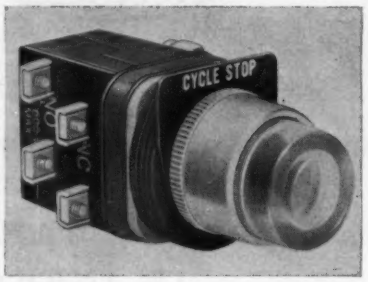
High-Voltage Surge Tester . . .

Type *507*, a specialized oscilloscope, was designed primarily for high-voltage surge testing of power transformers, high-voltage insulators, and lightning arresters. A 10-step input switch selects attenuation of 10% of the input signal per step. Eleven calibrated sweep rates are provided which can be triggered internally or by an external signal. **Tektronix, Inc., P. O. Box 831, Portland 7, Oreg.**



Illuminated Push Buttons . . .

These combination pilot light heavy-duty contact units that are sealed to exclude oil and coolants have double break NO-NC contacts of silver alloy that never require maintenance. Flexible circuitry permits the pilot light to go ON or OFF when the button is pressed or energized from a separate source. A built-in step-down transformer permits the use of rugged 6-volt pilot lamps. **Allen Bradley Co., 136 W. Greenfield Ave., Milwaukee, Wis.**



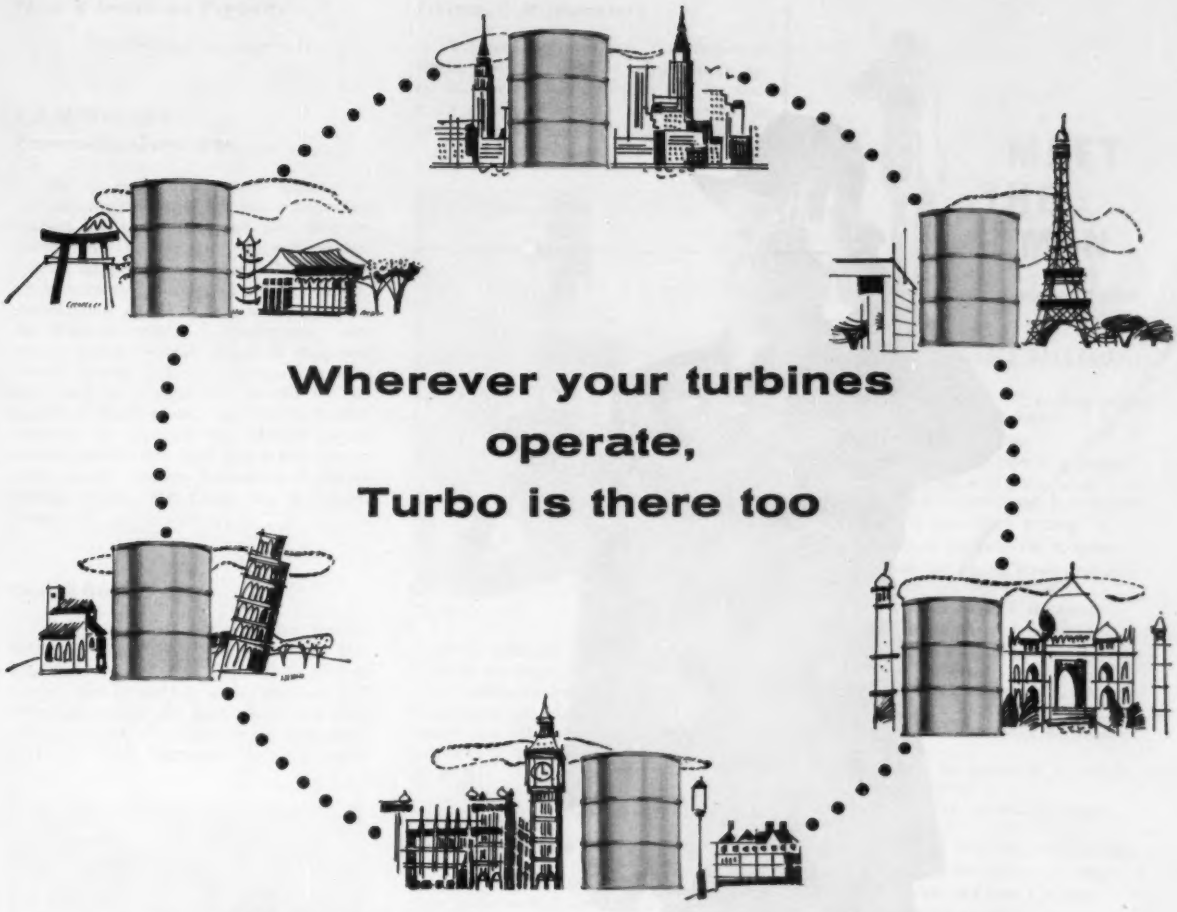
Electronic Level Gauge . . .

Accuracies of $\frac{1}{10}$ inch over a 10-foot range can be achieved with this all-electronic instrument that requires no moving parts. The height of the material produces a change in capacitance which is measured by a self-balancing bridge so that the readout is the shaft rotation of the servo rebalance. Readout may be in dial or counter form or built into a standard 11-inch strip chart recorder. The gauge is suitable for a wide range of electrically conductive liquids or granular solids, such as kerosene, liquid oxygen, water, nitric acid, and grain. **Magnetic Instruments Co., Inc., 546 Commerce St., Thornwood, N. Y**

Precision Limit Switch . . .

These small heavy-duty switches incorporate a movable contact assembly using two oppositely opposed compressed coil springs to provide a snap make–break action. A leaf spring carrying the contacts assures adequate contact pressure at all times. **Cutler-Hammer Inc., 475 N. 12th St., Milwaukee 1, Wis.**

(Continued on page 21A)



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. . . who knows wire and cable
. . . who is backed by engineering specialists
. . . who is backed by a reliable manufacturer

YOUR ROME CABLE SALESMAN

New & Improved Products

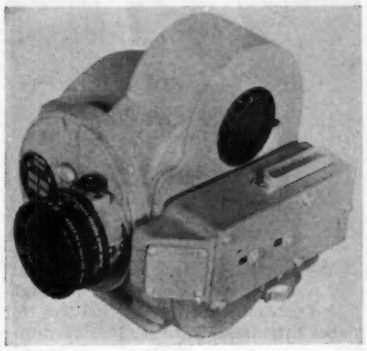
(*Continued from page 18A*)

1.5 Millisecond Emergency Generator . . .

In the event of a power failure, this emergency generating set can restore full voltage in 1½ milliseconds—the time required for the voltage regulator to act. Consisting of a synchronous dynamo flywheel magnetic clutch and a diesel engine, the dynamo acts both as a motor to drive the flywheel and as a synchronous condenser when normal power is supplied. Should power fail, the dynamo immediately acts as a generator driven by the inertia of the flywheel. This inertia is then applied to starting the diesel engine which assumes full load about one second after power failure. **Consolidated Diesel Electric Corp., 880 Canal St., Stamford, Conn.**

Coded Data Camera . . .

Designed to record a 96-bit matrix image on each frame of 35-mm film, this modified Bell & Howell motion picture camera can be used to make pictorial records simultaneously with time, temperature, pressure, vibration, stress deflection, shaft position, elevation, azimuth, and



similar data. Digital information recorded by means of two 48-lamp assemblies, each no larger than a postage stamp, is projected on the film by means of a prism relay. **Traid Corp., 17136 Ventura Blvd., Encino, Calif.**

Tapeless Underground Connector . . .

Designed for residential and industrial distribution systems, this underground connector will provide a fully insulated, watertight junction for eight electrical cables. The device features ease of installation, no plastic parts to crack or chip, wide cable range accommodation, and no extra bushings to fit different installations. **Dossert Mfg. Corp., 249 Huron St., Brooklyn, N. Y.**

Electronic Micrometer . . .

Particularly suitable for industries working with fragile or compressible materials, measuring pressures can be used from zero pressure up to 20 grams, depending on softness or hardness of the

material involved. Capable of making 20 or more readings per minute to accuracies of 20 millionth by direct digital readout, this electronic micrometer is its own reference standard eliminating the need for jo-blocks. **J. W. Dice Co., Englewood, N. J.**

Universal Flame Detector . . .

The heart of this flame detection device is a newly developed ultraviolet–sensitive tube that works with an amplifier circuit to add up the impulses of electrical energy generated by the tube as it counts the ultraviolet rays present in all types of flame. Inasmuch as all types of flames emit light in the ultraviolet spectrum, this detector can be used with all types of fuels or in applications where hot refractories, incandescent light, hot metal parts, or any flickering radiation in the visible infrared region would otherwise be sensed. **Minneapolis-Honeywell Regulator Co., 2747 Fourth Ave. South, Minneapolis 8, Minn.**

Dead Reckoning Analyzer . . .

A dead reckoning analyzer that automatically indicates a vessel's latitude and longitude on speedometer-like dials relieves the navigator of the burdensome chore of plotting position at short intervals or whenever the vessel changes course. The ship's initial position is introduced manually by latitude–longitude knobs. Course and speed can be fed in manually or automatically by hookup with the gyrocompass and the ship's log data. **Radio Corp. of America, 30 Rockefeller Plaza, New York 20, N. Y.**

(*Continued on page 22A*)

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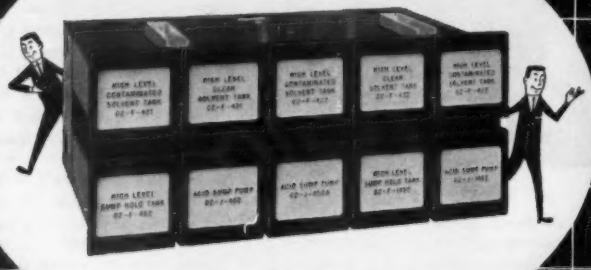
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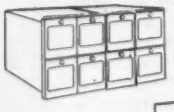

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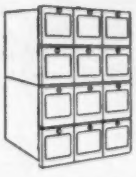
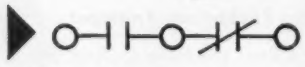


AUXILIARY CONTACTS N.O.—N.C. standard with most plug-ins.



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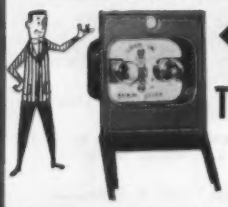

SEQUENCE OPTION after installation by means of independent slide switch at each point.

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New & Improved Products

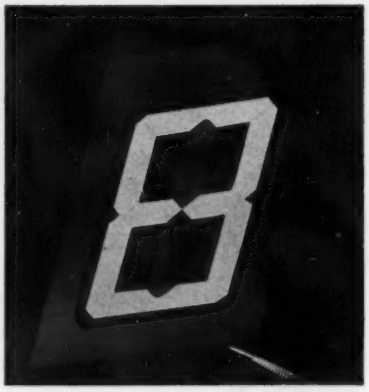
(*Continued from page 21A*)

New Silicon Rectifier Line . . .

Rounding out a full line of silicon controlled rectifiers, users now have 74 new, and 16 revised types to choose from. In the new low-current series, 37 are stud- and 20 are lead-mounted cells. In the revised high-current group, eight peak inverse voltage classifications are available ranging from 100 to 500 volts. Literature is available on request. **General Electric Co., Electric Components Division, 200 Main Ave., Clifton, N. J.**

Electroluminescent Indicator Lamps . . .

Now in production, these thin flat Rayescent readout lamps are available in two sizes and two voltage designs. The larger size, 4-5/32 inches high by 3-5/32 inches wide by approximately 5/16 inch deep is available in both numerical and alphabetical types. Voltage requirements



are 240 or 460 volts at 60 or 400 cps. Compact transistor-type power packs are available for converting 60 to 400 cps for higher brightness. Normal rated operating life is 3,000 hours. **Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J.**

Bright-Screen Radar . . .

A miniature, airborne radar receiver that produces a picture 20 times brighter than the average home television set provides clear, visible target blips in bright daylight. The extreme brightness on the radarscope is achieved through the tube's capacity to store electrostatic images. Weak targets that may not be shown reliably in other systems are collected by the storage tube until they become strong enough to be seen above noise interference. **International Telephone & Telegraph Corp., 67 Broad St., New York 4, N. Y.**

(*Continued on page 24A*)

POGO*

AUTOMATIC PROGRAMMING

for the Bendix G-15

Digital Computer

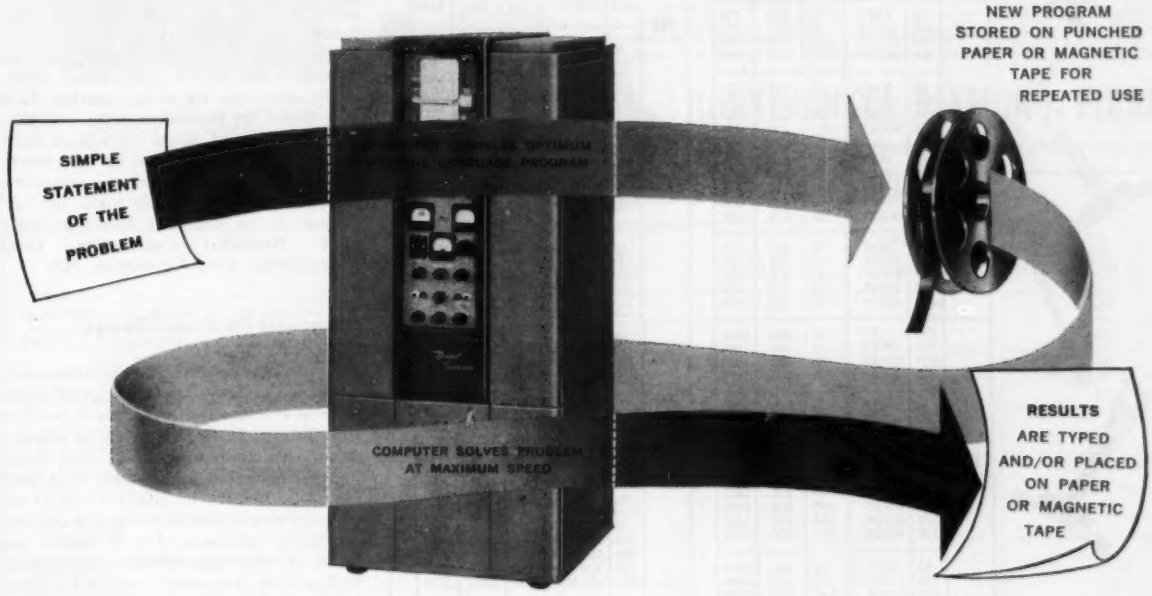
POGO is a new programming system that combines the use of simple, easy to learn commands with all of the G-15's machine language power and speed. A fixed point compiler, POGO recodes a simple statement of a problem in machine language with all commands stored in optimum memory positions. Thus, a programmer with very little training can write high speed production programs.

For the first time in a low-price computer, a set of fully self-contained automatic programming systems is available . . . POGO, with its ability to convert simple commands into fast and powerful machine language programs . . . and the already famous INTERCOM 1000 interpretive system, with its extreme programming simplicity and speed of preparation.

POGO commands are very similar to those used for INTERCOM 1000. The principal difference between the two systems is that POGO, unlike INTERCOM 1000, compiles an optimum machine language program and reproduces it for repeated use. Computing speed is also increased, since no interpretation is required during computation. While floating point INTERCOM 1000 is ideal for open shop problems, POGO may be preferred for production problems that must be solved repeatedly at high speed.

In POGO, data is handled in decimal form. Seventeen accumulator registers are available, as well as twelve index registers, which can be used to modify the effective address of any command. Additional data on the G-15, POGO, and INTERCOM 1000 will be sent on request.

* *Program Optimizer for G-15 Operations*


NEW PROGRAM STORED ON PUNCHED PAPER OR MAGNETIC TAPE FOR REPEATED USE
SIMPLE STATEMENT OF THE PROBLEM
COMPUTER SOLVES PROBLEM AT MAXIMUM SPEED
RESULTS ARE TYPED AND/OR PLACED ON PAPER OR MAGNETIC TAPE

Bendix Computer

DIVISION OF BENDIX AVIATION CORPORATION, DEPT. K-10, LOS ANGELES 45, CALIF.

Tarzian

HIGH CURRENT SILICON RECTIFIERS

- Extremely Compact Design
- Positive or Negative Base Polarity
- Flush or Stud Mounting
- Vibration Proof Construction
- Low Cost

The extremely compact Flatline series of Tarzian Silicon Rectifiers features flush or stud mounting in either positive or negative base polarity. Special junction structure provides reliable operation in the most rugged applications.

20 to 200 Amps. — 50 to 400 P.I.V.

AMPERES D.C. (100° C)	PEAK INVERSE VOLTAGE	TARZIAN FLATLINE TYPE	MAX. RMS VOLTS	MAX. RECURRENT PEAK AMPERES (100° C)	MAX. SURGE AMPERES 4MS
20	50	5RAN*	35	120	200
	100	10RAN	70	120	200
	200	20RAN	140	120	200
	300	30RAN	210	120	200
	50	5RAP**	35	120	200
	100	10RAP	70	120	200
	200	20RAP	140	120	200
	300	30RAP	210	120	200
35	50	5SAN	35	210	350
	100	10SAN	70	210	350
	200	20SAN	140	210	350
	300	30SAN	210	210	350
	50	5SAP	35	210	350
	100	10SAP	70	210	350
	200	20SAP	140	210	350
	300	30SAP	210	210	350
	50	5S3N	35	210	350
	100	10S3N	70	210	350
	200	20S3N	140	210	350
	300	30S3N	210	210	350
	400	40S3N	280	210	350
	50	5S3P	35	210	350
	100	10S3P	70	210	350
	200	20S3P	140	210	350
	300	30S3P	210	210	350
	400	40S3P	280	210	350
100	50	5VAN	35	600	1000
	100	10VAN	70	600	1000
	200	20VAN	140	600	1000
	300	30VAN	210	600	1000
	50	5VAP	35	600	1000
	100	10VAP	70	600	1000
	200	20VAP	140	600	1000
	300	30VAP	210	600	1000
	50	5V3N	35	600	1000
	100	10V3N	70	600	1000
	200	20V3N	140	600	1000
	300	30V3N	210	600	1000
	400	40V3N	280	600	1000
	50	5V3P	35	600	1000
	100	10V3P	70	600	1000
	200	20V3P	140	600	1000
	300	30V3P	210	600	1000
	400	40V3P	280	600	1000
150	50	5WAN*	35	900	1500
	100	10WAN	70	900	1500
	200	20WAN	140	900	1500
	300	30WAN	210	900	1500
	50	5WAP**	35	900	1500
	100	10WAP	70	900	1500
	200	20WAP	140	900	1500
	300	30WAP	210	900	1500
	50	5W3N	35	900	1500
	100	10W3N	70	900	1500
	200	20W3N	140	900	1500
	300	30W3N	210	900	1500
	400	40W3N	280	900	1500
	50	5W3P	35	900	1500
	100	10W3P	70	900	1500
	200	20W3P	140	900	1500
	300	30W3P	210	900	1500
	400	40W3P	280	900	1500
200	50	5XAN	35	1200	2000
	100	10XAN	70	1200	2000
	200	20XAN	140	1200	2000
	300	30XAN	210	1200	2000
	50	5XAP	35	1200	2000
	100	10XAP	70	1200	2000
	200	20XAP	140	1200	2000
	300	30XAP	210	1200	2000
	50	5X3N	35	1200	2000
	100	10X3N	70	1200	2000
	200	20X3N	140	1200	2000
	300	30X3N	210	1200	2000
	400	40X3N	280	1200	2000
	50	5X3P	35	1200	2000
	100	10X3P	70	1200	2000
	200	20X3P	140	1200	2000
	300	30X3P	210	1200	2000
	400	40X3P	280	1200	2000

*N in type number indicates negative base.
**P in type number indicates positive base.

WRITE FOR COMPLETE INFORMATION

SARKES TARZIAN, INC., Rectifier Division

DEPT. E-1, 415 NORTH COLLEGE AVE., BLOOMINGTON, INDIANA

In Canada: 700 Weston Rd., Toronto 9, Tel. Roger 2-7535 • *Export:* Ad Auriema, Inc., New York City

New & Improved Products

(*Continued from page 22A*)

Fused Teflon Tape . . .

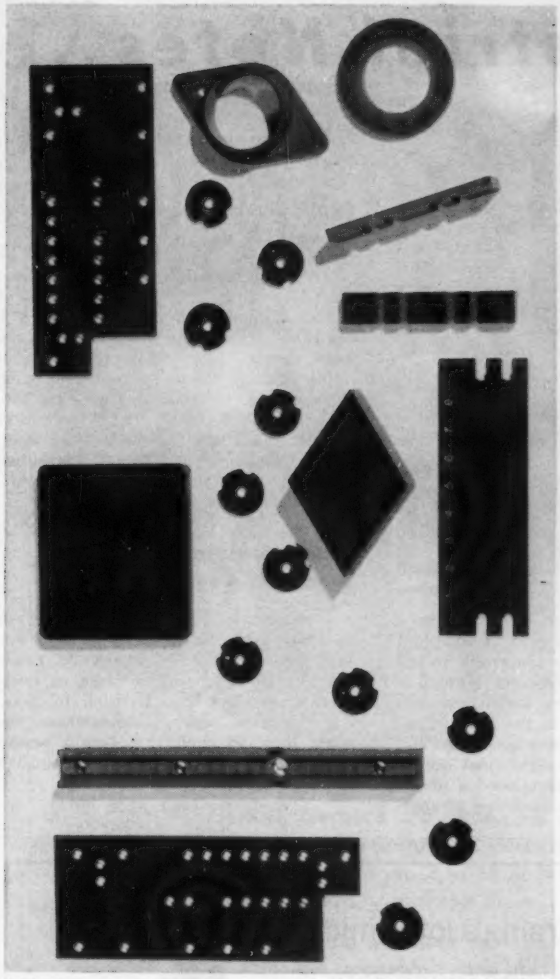
Made by skiving Teflon billets, these tapes feature excellent electrical properties, resistance to all common chemicals, a low coefficient of friction, and a surface to which nothing will stick. The tapes are designed primarily for high-temperature and high-frequency wire and cable insulation. They may also be used as stock from which gaskets, seals, and miscellaneous small parts can be cut. When treated with a cementable back, these tapes can also be used as rub rail covers, hopper or chute liners, and for similar applications where the material's smooth and nonadherent surface prevents jamming of packages or bridging of sticky materials. **Continental-Diamond Fibre Corp., A Subsidiary of the Budd Co., Newark, Del.**

Antenna Pattern Analyzer . . .

Designed primarily to utilize r-f crystals in a video detector system, this instrument requires a maximum of only 1 microwatt r-f power to achieve a maximum range of measurement of 45 db (r-f) in one step. For greater versatility, a d-c biasing circuit is included to permit the use of conventional barretters, requiring a d-c bias between 0 and 10 milliamperes. The biasing circuit is designed so that the burnout of barretters cannot occur as a result of transients in the bias circuit. The *BA-7* is useful for measuring very high-power ratios such as occur in making antenna pattern measurements, leakage measurements on r-f transmission equipment, and cross-talk of r-f switches. It is also useful for determining the rejection coefficients of r-f filters outside of their pass bands, for calibration of attenuators, for field strength measurements when the influence of the detector upon the impedance to be measured should be negligible. **Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md.**

Ultrasonic Thickness Gauge . . .

Using the principle of ultrasonic resonance, minute measurement of variations in cylinder wall thickness is possible with this gauge. Measurement of straight or curved surfaces of cast iron, steel, aluminum, magnesium, brass, lead, glass, and most solid plastics can also be made where only one side of the material is accessible. A probing crystal is vibrated against the inside cylinder wall surface, sweeping as high as 4 mc per second until, at the same frequency, the wall thickness and crystal are in resonance. This resonance will then vary with the wall's thickness to be read out on an oscilloscope having an 11-inch scale calibrated for thickness variations as low as one-thousandth of an inch. **General Motors Corp., 1775 Broadway, New York 19, N. Y.**



Fabricated by CDF. Near the presses that produced the Dilecto laminates, these paper-base parts were machined to close tolerances by CDF specialists . . . quickly, accurately, economically for the purchasers. This is a random selection from the five grades described in the table below.

CDF Dilecto® paper-base laminates for the workhorse insulation jobs

For everyday mechanical-electrical parts that receive tough punishment and must have excellent physical and dielectric properties at low cost, the CDF phenolic paper-base line is outstanding.

Economy. CDF paper-base grades machine readily into intricate parts. Some are flame-retardant. Others are especially adaptable for punching. All are economical for the value delivered.

Fabrication Facilities. CDF has excellent and extensive plastics-fabrication facilities for turning out finished Dilecto parts to your specifications—better and more economically than you can do it yourself. Save the time and trouble of intricate fabrication by using CDF's specialized facilities.

See Sweet's, Electronics Buyers' Guide, and the other directories for the phone number of the CDF sales engineer nearest you. Or send us your print or problem direct, and we'll return a recommendation of the right Dilecto grade for your need.

CDF makes Di-Clad* printed-circuit laminates, Diamond* Vulcanized Fibre, CDF products of Teflon†, flexible insulating tapes, Dilecto* laminated plastics, Celoron* molded products, Micabond* mica products, Spiral Tubing, Vulcoid*.

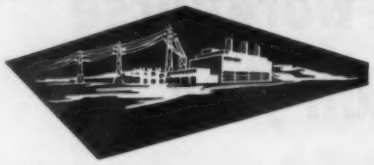
*Trademark of Continental-Diamond Fibre Corporation
†Du Pont trademark for its TFE-fluorocarbon resin

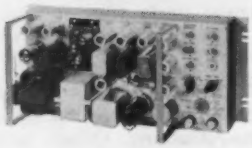
CONTINENTAL-DIAMOND FIBRE
A SUBSIDIARY OF THE Budd COMPANY • NEWARK 86, DEL.

Typical Property Values—Dilecto Paper-Base Laminates in Sheet Form

	X-13 (NEMA X)	XP-13 (NEMA P)	XX-13 (NEMA XX)	XX-13 FR (Fire-retardant) (NEMA XX)	XXXP-28 (NEMA XXXP)
ROCKWELL HARDNESS (M SCALE)	100	95	110	108	90
TENSILE STRENGTH lw (1000 psi.)	20	12	16	17	12
FLEXURAL STRENGTH lw (1000 psi.)	27	16	17	20	18
COMPRESSIVE STRENGTH (1000 psi.)	40	25	35	41	22
WATER ABSORPTION (% in 24 hrs.) 1/16" thickness	3.5	3.0	1.4	1.2	0.6
MAXIMUM CONTINUOUS OPERATING TEMPERATURE (°C.)	120	120	120	120	120
DIELECTRIC STRENGTH perp. to lam. (VPM)	800	800	650	700	800
DIELECTRIC STRENGTH parallel to lam. (Kv.)	50	50	60	70	75
DISSIPATION FACTOR at 1 mc, Cond. A	0.042	0.038	0.034	0.038	0.027
DIELECTRIC CONSTANT at 1 mc, Cond. A	5.5	4.6	4.7	4.8	3.6
ARC-RESISTANCE (seconds)	8	4	4	10	10
INSULATION RESISTANCE (megohms) ASTM D-257, Fig. 3	100	100	1,000	1,000	600,000
AIEE insulation class	A	A	A	A	A

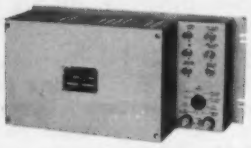
Telemeter ANY VARIABLE from Remote Points





MODEL 1025 Transmitter

MODEL 1090 Receiver



Accurate, Fast Acting, Frequency Type Telemeter for Transmission over Wire Lines, Microwave, and Power Line Carrier

Accurate HIGH-SPEED Continuous Telemeter for VOLTS AMPS WATTS VARS ETC.

•

Built-in Self-Calibrating Circuit

•

The Model 1025 Telemeter Transmitter converts DC mv from thermal converters, etc., to 10-30 cps which frequency modulates a built-in audio tone channel. AC 10 to 30 cps or relay outputs are also available. Receiver detects and demodulates transmitted signal, generating a DC mv for operation of recorders or indicating instruments. Up to 45 telemeters can be multiplexed.

Any communication link, including power line carrier, microwave or wire line may be used.

Over-all accuracy is 1% with a response speed of 1 second. Equipment features a built-in calibration circuit for 10% and 90% receiver check, and 10 cps and 30 cps transmitter check.

Any quantity which may be converted into a DC millivoltage or will operate a slidewire may be telemetered.

WE CAN HELP YOU
Our Applications Department is ready to assist you in your control, telemetering or communications problem. Phone DEerfield 4-3100.

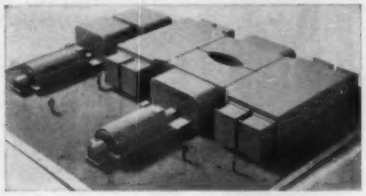
Write for Technical and Application Data.

Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

Industrial Notes...

Westinghouse Electric Corp. Pittsburgh, Pa. . .

An unusual turbine-condenser arrangement was developed by the Westinghouse Electric Corp., Box 2278, Pittsburgh 30, Pa., because basement space limitations in an existing plant made it desirable that the condensers be located on the turbine operating floor level of the Crawford Avenue Station of the



Courtesy Westinghouse

Commonwealth Edison Co. Instead of exhausting steam to the condenser in the conventional manner from the bottom of the turbine casing, the steam exhausts through two openings in the turbine casing located above the horizontal joint and on both sides of the longitudinal centerline of the unit. Engineers used a plastic model to determine the optimum arrangement of structural members in the low-pressure turbine casing.

Public Service Electric & Gas Co. Newark, N. J. . .

A safety citation from the Edison Electric Institute for the completion of a million man-hours of work without a lost-time injury was presented to the Essex electric distribution department of Public Service Electric & Gas Co. at its headquarters, Clinton Ave. and 21st St., Irvington, N. J. by E. H. Snyder, vice-president in charge of electric operation of the company. The record established by the Essex electric distribution department started on April 25, 1958.

Lockheed Aircraft Corp. Sunnyvale, Calif. . .

Because of the increasing emphasis on space projects, Lockheed Missiles Systems Division, Box 504, Sunnyvale, Calif., has formally changed its name to Lockheed Missiles and Space Division. In choosing the new name, consideration was given to a selection that would permit retention of the well-established initials LMSD.

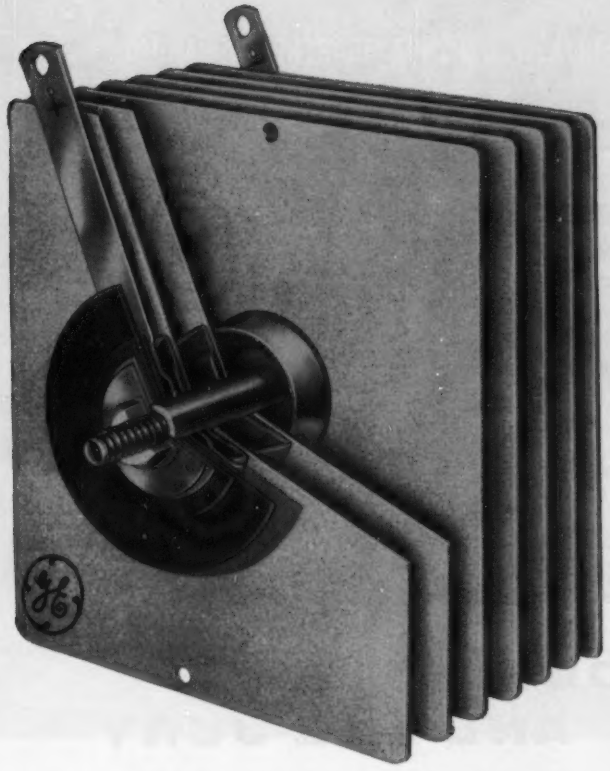
(Continued on page 30A)

Are you burning a lot of midnight oil when faced with tough wire and cable problems?

MEET THE MAN

WHO CAN HELP YOU

. . . on page 21A



New cup-washer selenium rectifiers

tighter assembly, improved paint seal for better protection

General Electric's new cup-washer design makes possible increased contact area between cells—resulting in lower contact resistance and improved surge ratings. Cells are rated from 2 to 15 amperes and can be stacked for higher currents. Other sizes will be available soon.

Special spring washers on both stack ends create a tighter assembly, both initially and throughout stack life. Size and weight can be reduced to save design space and give you a lighter unit with the same superior performance. Improved paint seal reduces the chance for contamination and eliminates paint penetration under the contact area.

New terminals provide holes for either screw or solder connections. Increased surge rating makes these rectifiers particularly well suited for welding equipment applications. The new assembly uses the same proved high-temperature Vac-u-Sel* rectifier cells which perform up to 130°C ambient.

Write for free booklet ECG-344, *Designing with G-E Vac-u-Sel Component Rectifiers*. General Electric Company, Semiconductor Products Dept., Section S184-59, Electronics Park, Syracuse, N. Y. For other information on industry's most complete line of selenium rectifiers, contact your G-E Semiconductor Product Sales Office.

Vac-u-Sel rectifiers are made by General Electric's spherical evaporation process, through which a pure, more even deposition of selenium over the entire cell surface is obtained. This results in longer life—even at high operating ambients and higher-than-normal rated current.

*Registered Trade-Mark of General Electric Company

GENERAL ELECTRIC

The Inquiring Mind at Oldsmobile

no. 8 OF A SERIES

THE SOUND . . . AND THE JURY

The quiet, solid feeling inside the 1959 Oldsmobile results from patient testing by a highly specialized "jury"—experts in the field of sound analysis.

Unlike most other phases of automotive engineering, there are no instruments which measure the "annoyance" factor of sounds inside an automobile. Subjective, personal evaluation known as the "jury system" is the most important means of determining how quiet it is inside an Oldsmobile.

With the "jury system", several experienced engineers assemble in an acoustically treated room and listen to binaural tape recordings made inside a test car. Careful editing of the tape recording allows rapid side-by-side comparison between two different test conditions and eliminates reliance on memory since considerable time may elapse between actual tests. By pushing a button, each engineer casts a secret "vote" and then the tabulation of the results determines which test condition is superior.

For the greatest possible accuracy, considerable care is taken making the recordings. Special microphones are placed at points corresponding to the passengers' ears. The recording equipment is in a specially equipped vehicle which follows the test car over a "ride road" that is carefully constructed to excite the vibrations and sounds that occur under normal driving conditions.

Quality, like quietness, is not accidental. It is the deliberate effort by Oldsmobile engineers to *design* quality into every automobile they produce. You'll like the 1959 Oldsmobile—with its solid Body by Fisher—it's the quietest car built! Experience this quality for yourself by visiting your local Authorized Oldsmobile Quality Dealer as soon as possible.

OLDSMOBILE DIVISION
GENERAL MOTORS CORPORATION

OLDSMOBILE **Where Quality is Standard Equipment!**

NOMINAL WEIGHTS OF FINISHED WEATHER-RESISTANT WIRE AND CABLE

(Pounds per 1000 Feet)

Conductor Size AWG or Mcm	Copper & Copper Alloy Conductors: URC Type Double Braid	URC Type Triple Braid	Neoprene Type	Polyethylene Type	Aluminum Conductors: Neoprene Type	Polyethylene Type
Stranded						
2	246	270	248	**230**	105	**87.4**
4	155	170	163	**143**	73.3	**53.3**
6	103	115	108	**91.5**	51.5	**35.0**
Solid						
2	239	260	232	**219**	92.2	**79.2**
4	151	164	152	**136**	64.0	**48.0**
6	100	112	101	**87**	45.7	**31.7**

Sources: American Standards Association Specifications

This table shows

POLYETHYLENE covered line wire weighs less

Because it's the lightest, polyethylene-covered line wire is the easiest for linemen to string up . . . hardest for ice and snow loading, gale-force winds to bring down.

Polyethylene-covered line wire, depending on size and conductor, weighs from 5% to 32% less than other types. That's what the figures in the specifications tabulated above show.

This, of course, is no news to linemen who have strung all types of weatherproof line wire. They may not be able to quote pounds and percentages, but they all know you can't beat polyethylene on weight.

Linemen's Favorite Material

Light weight means easy handling, one of the main reasons polyethylene rates tops with installation crews. They also like polyethylene wire because it's clean . . . free-stripping . . . has a smooth, self-lubricating surface that almost makes pulling a pleasure. And despite the exterior slip, the plastic covering hugs the conductor tightly, doesn't ruffle as it goes over crossarms.

"Built-in" Safety Factor

Polyethylene's lightness provides lasting mechanical advantages, since span loads don't tax supports as much as heavier type wire. This "built-in" weight safety factor pays off when violent storms push aerial construction to strain limits . . . when ice and snow loads topple heavier lines.

An added factor in polyethylene wire's ability to stay up under adverse conditions is its smaller diameter. It offers less resistance to wind, a smaller surface for ice build-up.

Winning Combination

Called the "closest to the ideal covering for line wire," polyethylene is outstanding in other respects too. The shield it forms over wire is continuous . . . tough . . . resistant to aging, weathering, moisture, abrasion by lashing branches. It's good for decades of superior service marked by fewer outages, minimum maintenance.

When you order covered wire and cable, make sure the coating is made with PETROTHENE® polyethylene resins. PETROTHENE polyethylene costs no more, but it gives you premium weather and stress-crack resistance.

Polyethylene's advantages are outlined in an informative new U.S.I. data sheet, "Polyethylene . . . The Best Line Wire Covering." Also available is a data sheet showing properties, applications and specifications of PETROTHENE polyethylene compounds. Send for your copies today.

U. S. Industrial Chemicals Co.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.

Please send me:
☐ "Polyethylene . . . The Best Line Wire Covering"
☐ "PETROTHENE Resins for the Wire and Cable Industry"

Name:_____ Title:_____

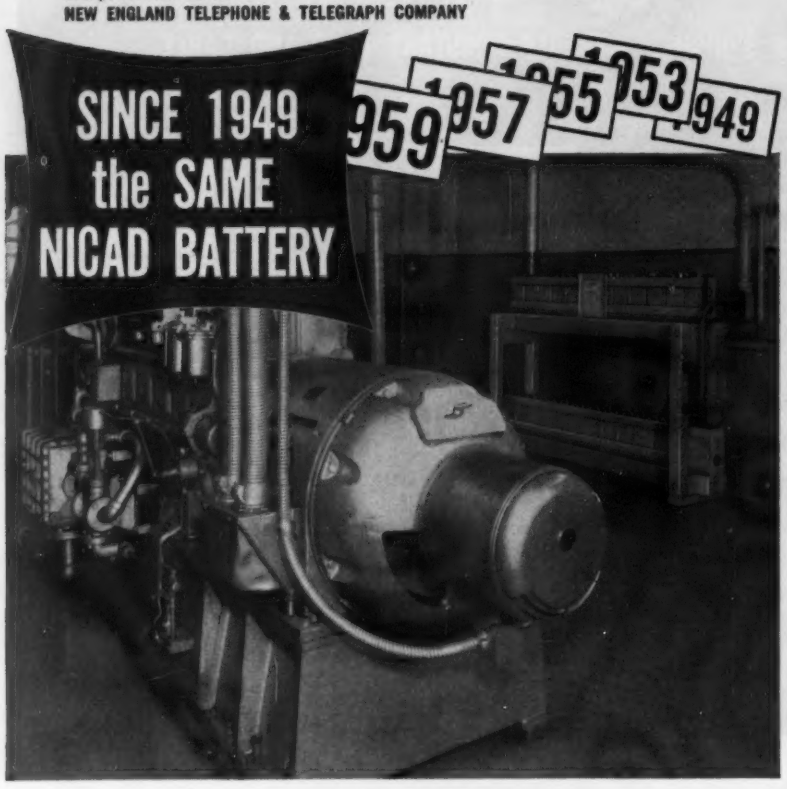
Company:_____

Address:_____

City:_____ State:_____

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York, 16, N. Y.
Branches in principal cities

In a power room of the
NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY



has been a RELIABLE SOURCE of engine starting power... at low annual cost

In April, 1949 a NICAD nickel cadmium battery, 32v, 168AH, replaced shorter service life batteries as the starting power source for this large diesel alternator at an exchange building of New England Telephone & Telegraph Co. Twenty-five cells, rated at 1.3v per cell, are connected in series to supply 32v.

And for ten years this NICAD unit has performed perennially "like new"... virtually inspection and maintenance-free.

Deterioration... corrosive fumes... plates that buckle and swell... frequent, costly service... abrupt, unexpected failure—these are the hazards industry avoids by selecting reliable NICAD Batteries for gas and diesel engine starting, supervisory control, emergency lighting, switch tripping, and similar applications.

For more information on NICAD heavy-duty batteries, request Bulletin 200 from NICAD Division, Gould-National Batteries, Inc., Easthampton, Mass.

NICAD
TRADEMARK

NICKEL CADMIUM
ALKALINE
STORAGE BATTERIES

Industrial Notes

(*Continued from page 26A*)

General Atomic San Diego, Calif...

In a new program to promote "Atoms for Peace" in Asia, General Dynamics Corporation, P.O. Box 608, San Diego 12, Calif., will assist the Republic of Korea in establishing a National Atomic Research Institute under provisions of the financial grant to Korea announced in Washington, D.C., by the United States Atomic Energy Commission. General Dynamics will send scientists and engineers of its General Atomic Division to Korea to serve as consultants in determining the requirements of the Institute, including design of the Institute's initial buildings, various laboratories, and other facilities, as well as the procuring of scientific equipment. They also will help set up experiments and organize courses for the training of personnel. The Korean Government, in turn, will send scientists, engineers, and technicians to General Atomic Division's John Jay Hopkins Laboratory for Pure and Applied Science in San Diego, Calif., where they will work with the Laboratory's distinguished staff and participate in its many programs of nuclear research and development.

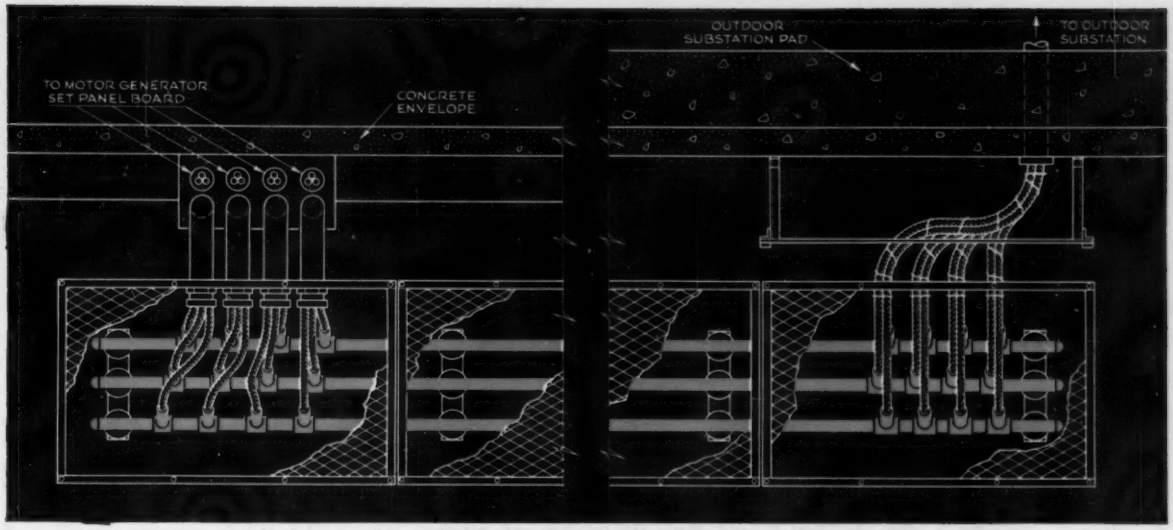
Inso Electronic Products, Inc. Union, N. J...

Inso Products, Ltd., has changed its name to Inso Electronic Products, Inc. The change was announced by H. N. Leitman, president of Adam Consolidated Industries, Inc., of which the company is a wholly owned subsidiary. The general sales office has been moved from the Adam offices at 404 Fifth Ave., New York, N.Y., to the Inso plant, 1200 Commerce Ave., Union, N.J. The company will continue to manufacture fused-film Teflon insulated wire and cable. The new name is said to be in keeping with the company's broadening scope of operation and the increasing diversification of its role in the electronics industry.

Technical Reproduction Service Newark, N. J...

Easier and more effective use of engineering drawings has been made possible with the introduction of Photoneering, a new process that combines photography and drawing. Specifications can be drawn directly on a photograph taken from any angle or point of perspective. A special heat and humidity resistant plastic film sheet is used, which permits necessary changes or erasures. Photoneering is particularly useful in plant modifications, model layouts, new products, and field changes of equipment. Sample and literature are available from Technical Reproduction Service, 375 South St., Newark 5, N.J.

(*Continued on page 32A*)



Side elevation of secondary bus system, using round tubular copper bus conductors, 2½" S.P.S., in unused plant tunnel. The run is approximately 275 feet long.

Round copper tube bus carries more amperes per pound of copper—cuts installation costs

When a large eastern electrolytic refinery recently shifted to purchased electric power, it capitalized on the electrical and mechanical advantages of round tubular copper bus conductors to effect some economies.

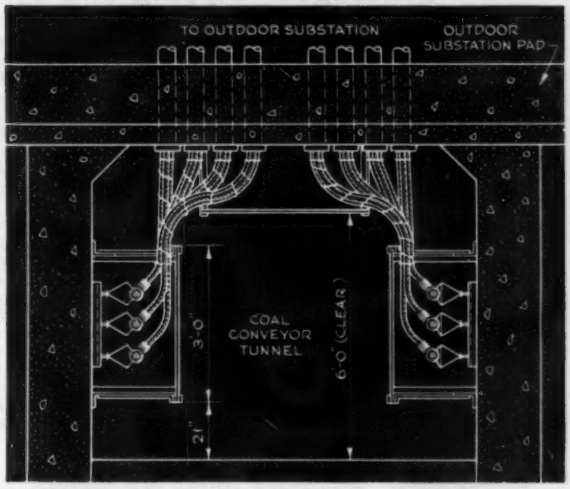
Directly below the 10,000 kv-a outdoor substation was an unused coal conveyor tunnel that ran some 275 feet back to the former powerhouse. In this, the secondary bus system using 2.3-kv high-conductivity bus tube, 2½" S.P.S., was installed as shown in the drawings.

These round conductors, having an extremely low skin-effect ratio (1.01) can carry well over 300 amperes per pound of copper—compared with less than 275 amperes per pound for rectangular bus of the same cross-sectional area.

In addition to this material saving, round conductors in standard pipe sizes made possible installation savings through the use of stock-size supports, connectors, and other hardware.

Substantial savings are often possible through the use of a tubular bus with a low wall-thickness-to-diameter ratio. More complete information on tubular conductors is available in the Sixth Edition of The American Brass Company's Publication C-25. This 62-page booklet has a wealth of general information on the properties of copper conductors—plus convenient data for the most commonly used sizes of all types of rigid bus conductors.

TECHNICAL SERVICES. Anaconda specialists are available to help you in the solution of technical problems involving the use of Anaconda Bus Conductors. For such service, or for a copy of Publication C-25, see your nearby Anaconda representative. Or write: The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass, Ltd., New Toronto, Ontario. 8969



End elevation of tunnel showing how bus conductors are mounted on either wall, covered by a simple expanded metal enclosure.

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COPPER CONDUCTORS

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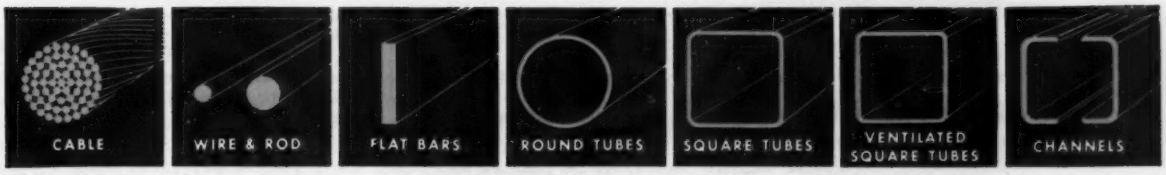


C&D AutoCal*
Unitized Power-Pack

Popular mounting arrangement shows how *AutoReg*® Silicon Charger mounts inside switchgear cubicle door with controls projecting through. No manual switching or other adjustment required. PlastiCal® batteries need watering only once a year.

New C&D *AutoCal** *unitized* Power-Pack is specially designed for dependable switchgear tripping and control

Simple *AutoReg*® voltage regulated, current limiting Silicon Charger, paired with long-life PlastiCal® battery, assures high-capacity d-c power in compact package that is virtually *maintenance-free.*

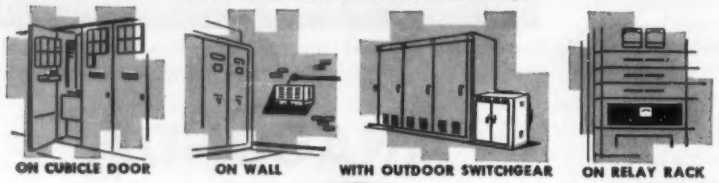
Now, utilities and industrial plants can guarantee an even greater margin of reliability and protection for switchgear and control equipment. The amazing new C&D *AutoCal unitized* Power-Pack always assures full power for tripping and control.

Here, for the first time, is a dependable, high-capacity power package *specially designed for tripping and control.* Virtually maintenance-free . . . with no manual switching or adjustment required . . . *AutoCal* provides many times the life of ordinary battery and charger combinations which may be *adapted* to this critical service.

AutoCal pairs the simple, compact *AutoReg* Silicon Charger with powerful PlastiCal lead-calcium-grid control batteries. A sudden demand for tripping power merely discharges the battery over a short period. While the breaker is tripped, PlastiCal supplies any necessary constant load current as might be required for the operation of pilot lights, holding coils, and similar requirements. Once the circuit is reclosed, *AutoReg* puts energy back into the battery at a high rate until it levels off at full charge.

Here's self-protected charging . . . no charger adjustment or maintenance . . . and 25-year-life PlastiCals only require watering once a year!

For full details—write for Bulletin AR-102 today!



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**Trademark: AutoReg® Silicon Charger and PlastiCal® Battery.*

Industrial Notes

(Continued from page 30A)

Bowmar Instrument Corp. Ft. Wayne, Ind. . .

More than 6,000 square feet of floor space have been added to the Bowmar Instrument Corp. facility at 8000 Bluffton Rd., Ft. Wayne, Ind. The new area is for the company's engineering and sales groups. New construction has taken the form of a second floor at the front end of the present plant.

Remington Rand New York, N. Y. . .

Small businesses will now be able to benefit from the establishment of their own data-processing centers using the Univac low-cost punched-card system which is specially tailored for economy of installation, maintenance, and operation. It can be used in processing payrolls, accounts receivable, production and inventory control, and for sales, market, and budget analysis. Large companies can also benefit from the system, it was pointed out, since its economy will enable them to set up decentralized installations for data processing in branch offices and plants. Remington Rand, Division of Sperry Rand Corp., 315 Fourth Ave., New York 10, N.Y.

Sprague Electric Co. North Adams, Mass. . .

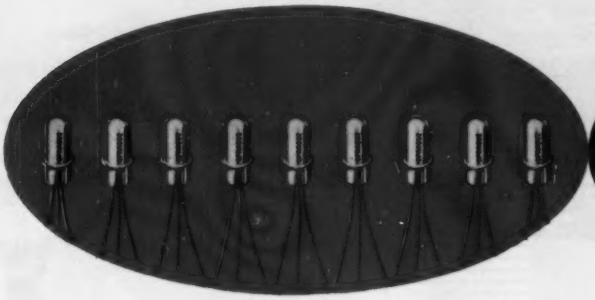
The magnetic component and filter product lines of the Hycor Division of the International Resistance Co., Philadelphia, Pa., have been purchased by the Sprague Electric Co., 235 Marshall St., North Adams, Mass. The company will take over the manufacture of the various Hycor product lines including magnetic amplifiers, saturable reactors, high-frequency electronic power transformers, toroids, decade inductors, low-pass and precision band-pass filters for communications, telephone, and sound recording applications, telemetering filters, and broadcast and sound recording program equalizers.

Edal Industries, Inc. New Haven, Conn. . .

Formation of a company to manufacture a high quality stabilized instrument rectifier, copper oxide and selenium diodes, selenium rectifiers, diode modulators, demodulators, phase comparators, and varistors has been announced by Edal Industries, Inc., 64 Franklin St., New Haven, Conn.

(Continued on page 34A)

new transistors from Sprague*



SUPER HIGH-SPEED SWITCHING TRANSISTORS TYPE 2N501

	Typical	Maximum	Units
Rise Time (t_r)	9	18	mμsec
Storage Time (t_s)	9	12	mμsec
Fall Time (t_f)	7	10	mμsec

In circuit with current gain of 10 and voltage turnoff.

Also available as special type 2N501A for 100° C. maximum storage and junction temperatures.

This table tells the story. Sprague Type 2N501 germanium micro-alloy diffused-base transistors are the fastest mass-produced transistors available anywhere! They are unexcelled for high-speed computer applications. The ultra-low rise, storage, and fall time cannot be matched by any other transistor.

Ultra-precise process control in manufacture results in superb and consistent high quality. The basic electrochemical process of fabrication takes the guesswork out of transistor manufacturing. The result is outstanding uniformity of product.

Because of the electrochemical process, Sprague is able to fabricate a graded-base transistor with no intrinsic base region. The Type 2N501 can thus maintain its super high-speed switching characteristics right down to its saturation voltage, providing all the advantages of direct-coupled circuitry with no impairment of switching speeds.

Type 2N501 Transistors are available from Sprague now at extremely reasonable prices. They are transistors you can use today! You need not delay your development work for the future when you design high-speed switching circuits with Type 2N501 Micro-Alloy Diffused-Base Transistors.

Write for complete engineering data sheet to the Technical Literature Section, Sprague Electric Company, 321 Marshall Street, North Adams, Massachusetts.

* *Sprague micro-alloy, micro-alloy diffused-base, and surface barrier transistors are fully licensed under Philco patents. All Sprague and Philco transistors having the same type numbers are manufactured to the same specifications and are fully interchangeable.*

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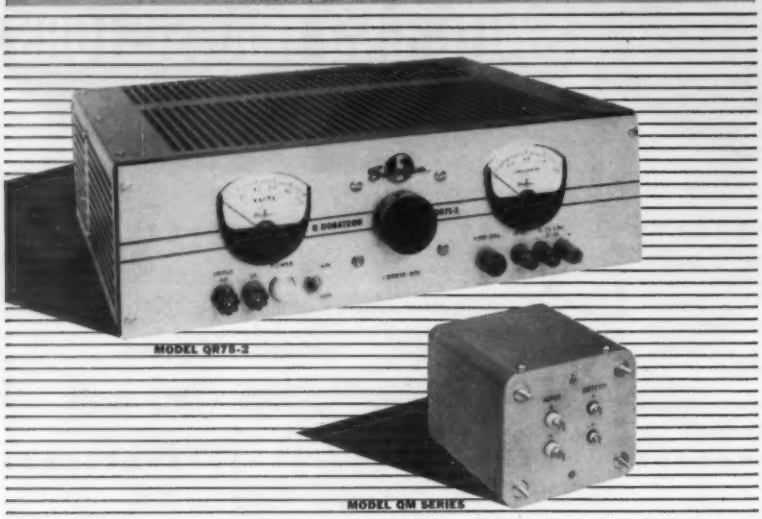

3 new Sorensen transistorized d-c supplies can solve your lab, production and design problems

In the Sorensen "Q" Series, you can select from the most complete line of fully transistorized, highly regulated low-voltage d-c supplies on the market: **QR-Nobatrons,** (shown above, left) with output continuously adjustable down to zero volts, are ideal for labs or wherever maximum flexibility is required. Two models, QR36-4A and QR75-2, put out respectively 0-36V at up to 4 amps and 0-75V at 2 amps. Regulation of QR36-4A is ±0.025% or 4 MV for combined line and load variations. Input: 115vac 50-400 cps available for either bench or rack-panel (5½" x 19") use.

Q-Nobatrons®, with 2:1 adjustable output, can render outstanding service in semi-permanent lab set-ups, in production test, or integrated into your own product. Available in 15 models up to 200 watts capacity with 6, 12 or 28 volts out. Specs and packaging are similar to QR models above. Models for ±0.25% or ±0.05% regulation are available. Lower wattages are available two to a single rack panel (3½" or 5¼" x 19").

QM-Series, solder-into-the-circuit supplies (shown above, right) mount like a potted transformer or choke and come in 36 variations: nine voltages from 3.0 to 36vdc, regulated ±0.05%; and four wattages, 2, 4, 8 and 15. Input 50/60 and 400 cps at 115vac. (Incidentally, Sorensen also offers similarly packaged DC-to-DC and DC-to-AC converters.)

Ask us, or your nearest Sorensen representative, for the complete story on these precision transistorized regulated d-c supplies. 8.42

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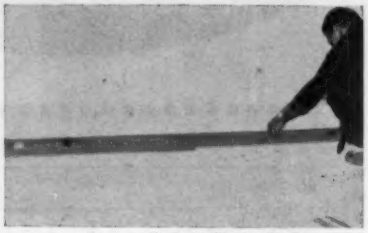
Industrial Notes

(*Continued from page 32A*)

National Electric Products Corp. Pittsburgh, Pa. . .

An entirely new electrical wiring system has been developed for use in the Pavilion Apartments, a prototype of five other skyscraper apartment houses in the Layfayette Park–University City project in Detroit, Mich. Called Baseduct, it is



Courtesy National Electric Products Corp.

an electrified metallic baseboard with multioutlet facilities and an integral wiring space which permits rewiring or servicing without disturbing plaster walls and without the tedious task of stringing wires inside walls. Baseduct was developed by National Electric Products Corp., 2 Gateway Center, Pittsburgh 22, Pa., for this particular project, but it has universal application.

Autonetics Downey, Calif. . .

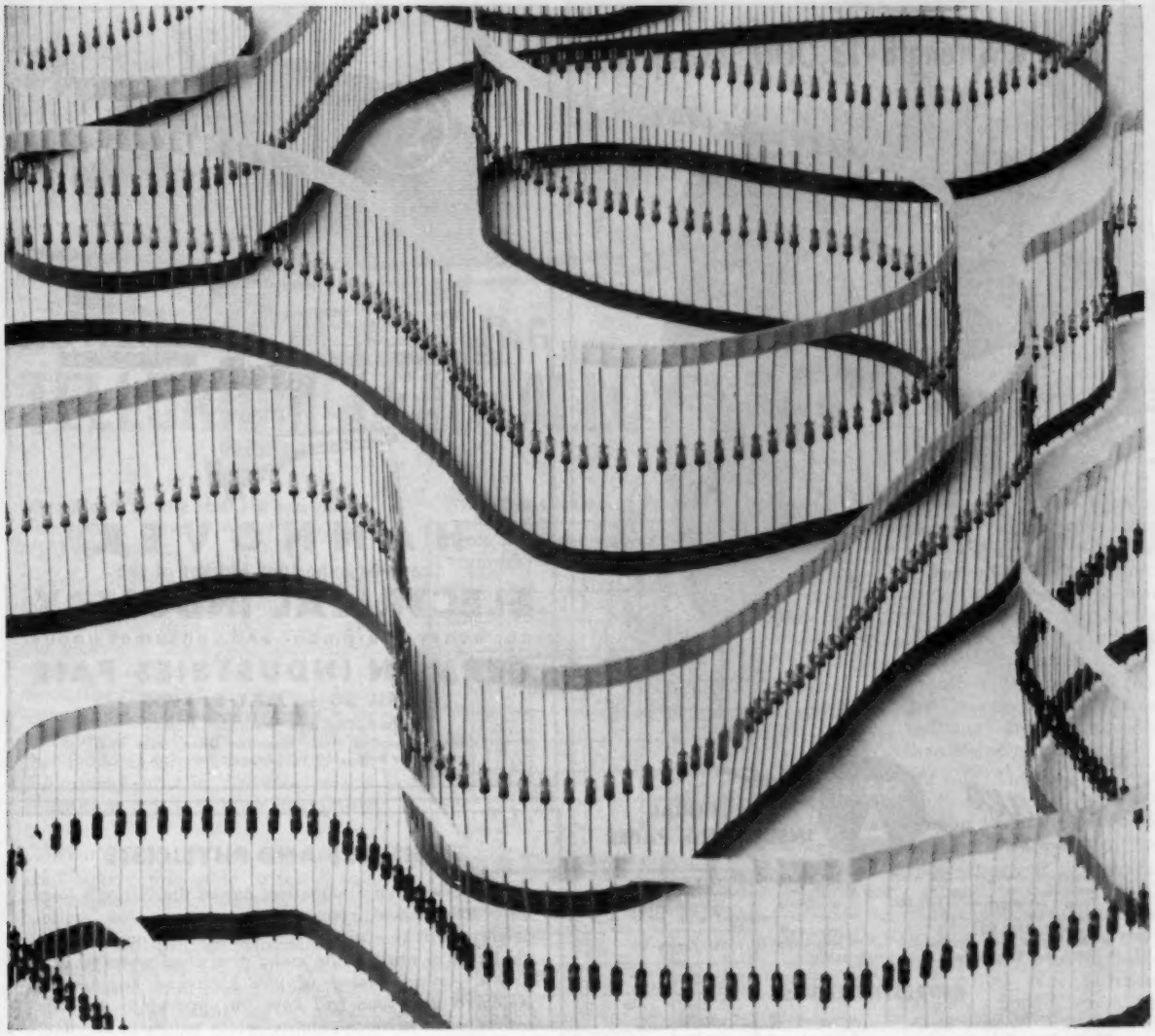
Establishment of a manufacturing engineering department in Autonetics, a Division of North American Aviation, 9150 E. Imperial Hwy., Downey, Calif., and appointment of E. H. Schaefer as chief of the operation have been announced.

Federal Pacific Electric Co. Newark, N. J. . .

A marketing department oriented to the customer has been established by Federal Pacific Electric Co,, 50 Paris St., Newark 1, N. J. The marketing operations will function through the joint efforts of line sales management and a headquarters marketing staff, both co-ordinated by the vice-president marketing.

General Electric Co. Lynn, Mass. . .

Full-scale manufacturing operations are under way in the new 59,000 square foot extension added to General Electric Company's Medium Steam Turbine, Generator and Gear Department, Lynn, Mass. In addition to steam turbine–generator units, the department also manufactures marine turbines and reduction gears, mechanical drive turbines and high-speed precision industrial gears as well as transportation gearing.



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Now you can get high-performance voltage-regulator diodes in the famous, hermetically-sealed Hughes glass envelope. These diodes have an outstanding characteristic: sharp regulation of reverse voltage. This means that you can use them—with confidence—in clipping, clamping, coupling, and compensation circuits to obtain *dependable voltage regulation*. In addition, they retain this stability, together with low dynamic resistance, throughout a wide range of operating temperatures.

CHARACTERISTICS

Nominal Voltage: 2 volts to 30 volts

Power Dissipation: 250 milliwatts

Maximum Dynamic Resistance: 10 to 75 ohms

Operating Temperature Range: —65° to 175° C.

Dimensions, Diode Glass Body: Maximum Length: 0.265″ max.
Maximum Diameter: 0.105″ max.

To obtain your copy of specifications covering the family of more than a dozen types of Hughes Silicon Voltage-Regulator Diodes, please write: Hughes Products, Semiconductor Division, Marketing Department, P.O. Box 278, Newport Beach, California.

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Dallas—Electrical Supply Corp.
Dallas—Summers Electric Co.
Denver—Electric Motor Supply Co.
East Rutherford, N. J.—Insulating Fabricators, Inc.
Forth Worth—Electrical Supply Corp.
Hamilton, Ontario—Buntin, Gillies & Co., Ltd.
Houston—Houston Industrial Supply Co.
Kansas City, Mo.—Ace Electric Co.
Los Angeles—Tri-State Supply Corp.
Minneapolis—D. A. Schultz Co.
Mobile—Russell Electric Co.
New York—Brownell Distributors, Inc.
Newark—Electric Motors & Parts Corp.
Oklahoma City—Butts Electric Supply Co.
Oklahoma City—John H. Cole Co.
Philadelphia—Electrical Maintenance Equipment Co.
Pittsburgh—Herbert J. Graham
Rochester—Allied Electrical Insulation, Inc.
Salt Lake City—J. R. Christenson Agency
San Francisco—Tri-State Supply Corp.
Seattle—Tri-State Supply Corp.
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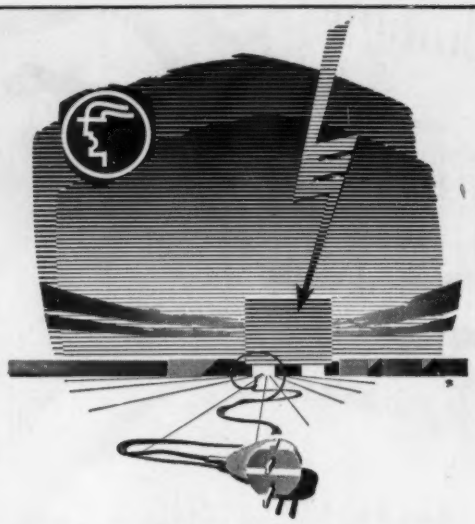

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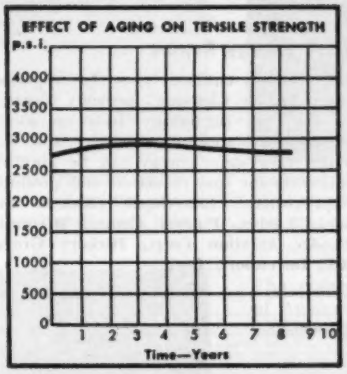
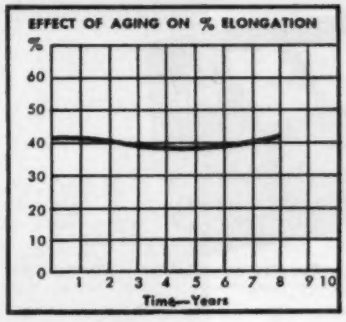
What's more, we asked the people who bought this cable to put it into the toughest service possible—in such installations as high risers, grades and underground installations where large cable movements and high temperatures prevail. And this gruelling service bears out what we've always maintained: Roebling Tellurium Lead Alloy Sheath has long term stability when it comes to tensile strength and elongation, high resistance to creep and bending fatigue.

These graphs of laboratory tests show effect of aging on tensile properties of Tellurium Lead Alloy Sheath.

TELLURIUM LEAD ALLOY SHEATH...





The exceptional quality of this sheath is one reason why Roebling has more Tellurium Lead Paper Power Cable in service than any other manufacturer. *Another* reason is the superb *inner* quality of this cable. Every step of construction represents scrupulous care. The paper tapes, for instance, are applied under uniformly controlled tension, to assure maximum insulation qualities. And every inch of the cable is tested—then tested again.

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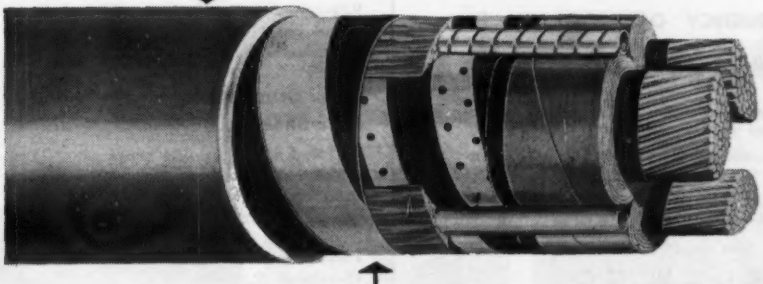

Uniform physical properties are easily achieved in a single operation with the tellurium alloy. This unique feature is but one of several which distinguish the tellurium alloy from other fatigue-resistant lead alloy sheaths.

Mammoth new taping and cabling machines, and the finest obtainable materials, are used to produce the carefully constructed "heart" of Roebling Paper Power Cables.

Trade Literature...

"Space Talk" Guide Translates Jargon . . .

A pocket-size down-to-earth glossary of astronautical terms has been published to guide laymen through the lexicographic labyrinth of space science. Dr. W. J. O'Donnell, chief engineer for aircraft and missile development at Republic Aviation Corp., points out in a foreword that in the 88 years since Jules Verne wrote his around-the-world classic some 28,000 words have been added to the average dictionary. **Republic Aviation Corp., Conklin St., Farmingdale, L. I., N. Y.**

Narmco Engineering Topics . . .

This publication, issued every other month, is distributed without charge to engineers, designers, and related technical personnel concerned with the use of sandwich construction, adhesive bonding, and structural plastics in the aircraft, missile, and many nonmilitary industries. **Narmco Resins & Coatings Co., 600 Victoria St., Costa Mesa, Calif.**

D-C Motor Data . . .

Catalog *11058* is a 16-page compilation of technical data which includes a discussion of the basic methods for operating d-c motors from a-c power sources. Typical schematic diagrams are included as representative of the more popular systems in general use. The remaining portion of the catalog includes specifications, speed and torque rating, etc., of the equipment manufactured by **Servo-Tek Products Co., 1086 Goffle Rd., Hawthorne, N. J.**

Blueprint Booklet . . .

A 32-page booklet titled "Better Products for Automation through Standardization," contains pictures, engineering drawings, and engineering data for the everyday application of precision gears and allied components. **PIC Design Corp., Subsidiary of Benrus Watch Co., Inc., 477 Atlantic Ave., E. Rockaway, L. I., N. Y.**

Sonic Energy Report . . .

A report entitled "How To Appraise Sonic Energy Cleaning" presents concisely the up-to-the-minute facts on sonic energy applications in industry and explains how sonic energy can be applied efficiently for cost reduction and product improvement. Letterhead requests to: **Sonic Energy, Pioneer Central Division, Bendix Aviation Corp., Hickory Grove Rd., Davenport, Iowa.**

How Silicones Reduce Insulator Flashovers . . .

A compact brochure, *Code 4-215*, describes how Dow Corning *5* Compound curtails arcs, short circuits, and the formation of leakage paths on insulators exposed to contaminated atmospheres. In addition to preventing conductive paths from forming, the *5* Compound is easy to apply and reduces cleaning time and costs. It can be removed without the use of solvents or abrasives, and the time intervals between cleanings are substantially increased because of the longer-lasting protection provided by this grease-like silicone compound. **Dow Corning Corp., Midland, Mich.**

Pressure Transducer Bulletins . . .

Three instrumentation bulletins technically describing a series of rugged, high performance pressure transducers explains the Model *DP-7* pressure transducer, Model *GP-15D* high-range pressure transducer, and Model *DP-15D* high range differential pressure transducer. They contain instrument descriptions, application information, and performance specifications. **BJ Electronics, Borg-Warner Corp., 3300 Newport Blvd., Santa Ana, Calif.**

Adhesives, Coatings, and Sealers Catalog . . .

A 12-page, illustrated catalog describing design concepts, typical applications, and general characteristics of adhesives, coatings, and sealers is available from the **Adhesives, Coatings & Sealers Division, Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.**

Nickel Alloy Wire Cloth and Mesh Booklet . . .

"Which Inco Nickel Alloy Can Solve Your Wire Cloth Problem?" is addressed to engineers, designers, and operators of equipment in the many fields which make use of wire cloth for filters, dipping baskets, core-support structures, and other applications. The booklet describes at length the physical advantages of wire cloth and indicates the range of weaves and sizes available for various purposes. Readers Service Section. **The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.**

Silver Braze Paste Data Sheet . . .

New silver brazing paste alloys, containing silver braze alloy, special silver braze flux, and special binders in homogeneous suspension, are described in an engineering data sheet recently issued by **Fusion Engineering, 17921 Roseland Ave., Cleveland 12, Ohio.**

(Continued on page 41A)

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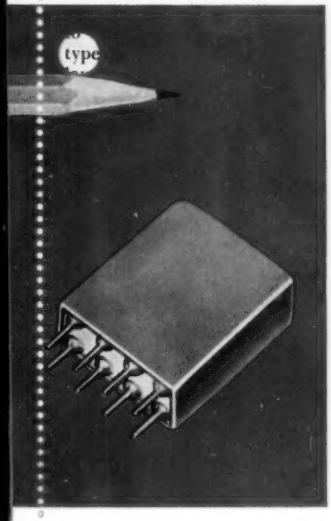
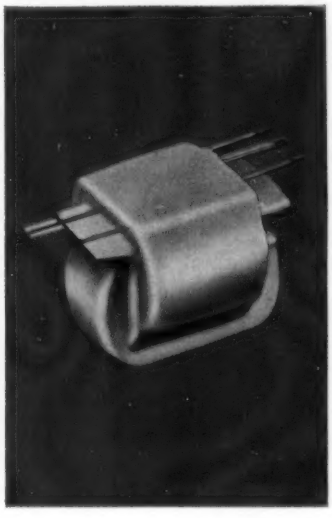
Anaconda EPOXY Magnet Wire for outstanding compatibility at high temperature

Epoxy's unique combination of dependable characteristics makes it suited to use in such equipment as totally enclosed motors, above; hermetically sealed relays, encapsulated dry-type transformers, below.

Anaconda Epoxy Magnet Wire is particularly well suited to use in oil-filled transformers. Epoxy's excellent behavior in transformer oils is but one of its many outstanding chemical characteristics.





The compatibility, chemical stability, and thermal stability, of Anaconda Epoxy have been proved by some three years of actual field experience, plus seven years of research and development, in both military and civilian applications.

Anaconda Epoxy (130°C AIEE Class B) magnet wire is compatible with most well known insulations. It offers excellent resistance to moisture, transformer oils, acids, and alkalies. Tests of Anaconda Epoxy magnet wire with all impregnating varnishes tried to date have resulted in chemically compatible systems—with no thermal deterioration of the Epoxy film.

Epoxy's unique combination of dependable characteristics makes it suited to a wide variety of difficult applications. Its outstanding dielectric strength, its heat-shock, adherence, and flexibility properties make it an "all around" magnet wire for use up to 130°C in either open or closed systems.

ROUND, SQUARE AND RECTANGULAR. Anaconda Epoxy magnet wire is available in the full range of round, square and rectangular sizes. It can also be furnished in combination with glass servings.

If you have a difficult Class B application or a troublesome job at lower temperature that might benefit from some other characteristic of Epoxy, see the Man from Anaconda. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N.Y.

68366

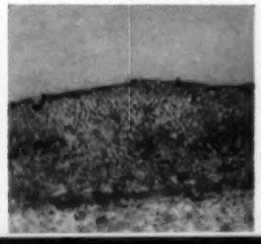
ASK THE MAN FROM **ANACONDA®** *about* **EPOXY MAGNET WIRE**

For more details on Anaconda Epoxy's unique combination of useful characteristics, please turn the page—

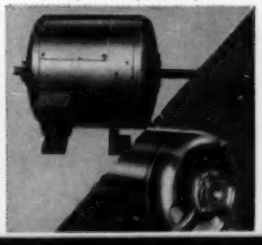
ANATHERM 155°C (AIEE Class F)
high temperature resistance

NYFORM 105°C (AIEE Class A)
superior windability

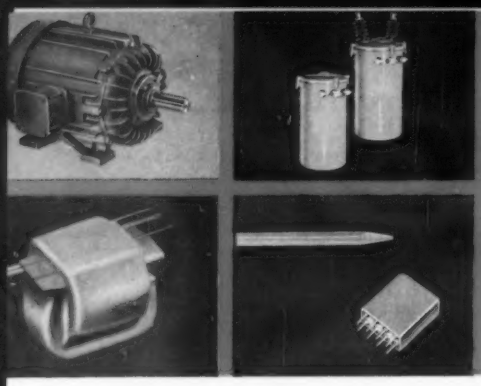
VITROTEX 130°C (AIEE Class B)
glass-insulated, high heat resistance



FORMVAR 105°C (AIEE Class A)
proven dependability



ANALAC 105°C (AIEE Class A)
solderable magnet wire



MAGNET WIRE DATA SHEET

from

Anaconda Wire & Cable Co.

IMPORTANT FACTS FOR YOUR WORK...

...about Anaconda Epoxy 130°C (AIEE Class B) Magnet Wire

Anaconda Epoxy film-coated magnet wire is suitable for use in 130°C (Class B) hottest spot operation. It meets MIL-W-19583 requirements. Epoxy is compatible with other insulations and performs excellently in oils. It offers unusual resistance to moisture and has a higher resistance to heat shock than other Class B wires. This unique combination of properties makes it applicable to a wide variety of difficult applications.

SUGGESTED APPLICATIONS

Oil filled transformers • Air conditioning systems where moisture is a problem • Refrigeration machines for operation with fluorinated hydrocarbon refrigerants • Totally enclosed motors, transformers, alternators • Encapsulated windings of virtually any type.

MECHANICAL PROPERTIES

Epoxy offers outstanding adherence and flexibility. It meets the exacting demands of abrasion resistance called for in high-speed winding machines.

ELECTRICAL PROPERTIES

Epoxy magnet wires exhibit high dielectric strength—a minimum of 2000 volts per mil under dry test conditions. The following are dielectric constant and dissipation factor measurements at 25°C and 50% RH:

Frequency Cycles per Second	*Dissipation Factor %*	*Dielectric Constant*
60	0.37	4.63
1,000	0.48	4.60
10,000	0.96	4.55
100,000	1.95	4.45

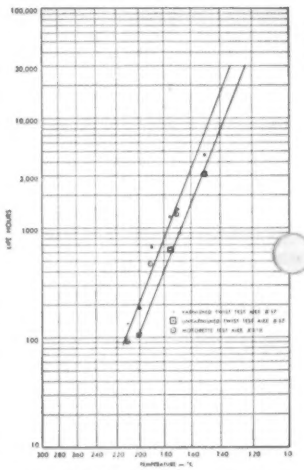
CHEMICAL PROPERTIES

Epoxy offers outstanding chemical characteristics. The Epoxy resins are characterized by their resistance to attack by compounds they may come into contact with when used in electrical apparatus. Epoxy shows exceptional resistance to 5% potassium hydroxide, 5% sulphuric acid, VM&P naphtha, ethyl alcohol, xylol, toluol. Epoxy wire has given excellent results in test programs designed to determine the effects of fluorinated hydrocarbon refrigerants. Scrape abrasion resistance is high under Freon. Freon 22 does not blister and attack the coating. Epoxy does not hydrolize in closed systems.

Epoxy is outstanding in its behavior in transformer oils. It will also withstand the action of lubricating oils at high temperature. In fact, such oils sealed in glass tubes with Epoxy wire and heated to 150°C do not damage the insulation, even when the oils have been contaminated by long use.

THERMAL PROPERTIES

Epoxy is a 130°C (Class B) magnet wire. This rating is based on AIEE test procedures. The wire is also intended for use at lower temperatures where the choice may be made to take advantage of some other characteristic. It also can be used at higher temperatures for shorter life or in some special applications. Please refer to the thermal stability chart.



Thermal stability, Epoxy round magnet wire

THERMOPLASTIC FLOW. Epoxy magnet wire meets the 200°C minimum requirement of Specification MIL-W-19583 for 130°C systems.

RETENTION OF FLEXIBILITY. Epoxy magnet wire can be heated for 168 hours at 125°C and then wound on its own diameter without cracking.

HEAT SHOCK. Epoxy magnet wire offers outstanding heat shock characteristics, as indicated by the following table (Wires are stretched or not stretched, then wound on mandrels having X times the diameter of the wire and placed in an oven at 155°C for one hour):

Prestretch %	*1X*	*3X*	*5X*	*10X*
0	Pass	Pass	Pass	Pass
10	Fail	Pass	Pass	Pass
15	Fail	Pass	Pass	Pass
20	Fail	Pass	Pass	Pass
25	Fail	Fail	Pass	Pass

MOISTURE RESISTANCE

Epoxy magnet wire can be used when sealed in electrical apparatus where water is contained in other materials. Small coils in water at room temperature for 18,000 hours (2.1 years) maintained a very high insulation resistance between the copper and water. Epoxy wires sealed in glass tubes with a small amount of water can be heated for a month at 150°C without destruction of the enamel coating.

All-Epoxy insulation systems. Materials are now available to make possible complete Epoxy systems that offer superior thermal and chemical stability and maximum environmental protection. Detailed information available on request.

TEAR OUT FOR YOUR FILE

EE-59

ANACONDA WIRE & CABLE COMPANY
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Please send me a copy of your Epoxy Magnet Wire Booklet.

NAME & TITLE.....

COMPANY.....

ADDRESS.....

CITY.....ZONE.....STATE.....

SEE THE MAN FROM

ANACONDA®

FOR MAGNET WIRE

Trade Literature

(Continued from page 38A)

Mountings and Joints Bulletin . . .

This 12-page product bulletin, No. *713*, describing full bonded tube form mountings and Dynaflex joints, specially engineered for vibration and shock control. Contains an application guide, performance characteristics and data, detailed specifications, typical applications and methods used for selection and installation. **Lord Manufacturing Co., 1635 W. 12th St., Erie, Pa.**

Reprints on Dalic Process . . .

The Dalic Fact File consists of four 2-page reprints of articles dealing with specific applications of the Dalic Process of selective plating and should be particularly useful to those firms or departments active in manufacture or maintenance of aircraft, electric motors, radar wave guides, printed circuitry, and machinery. **Marlane Development Co., Inc., 153 E. 26th St., New York 10, N. Y.**

Contactor and Relay Folder . . .

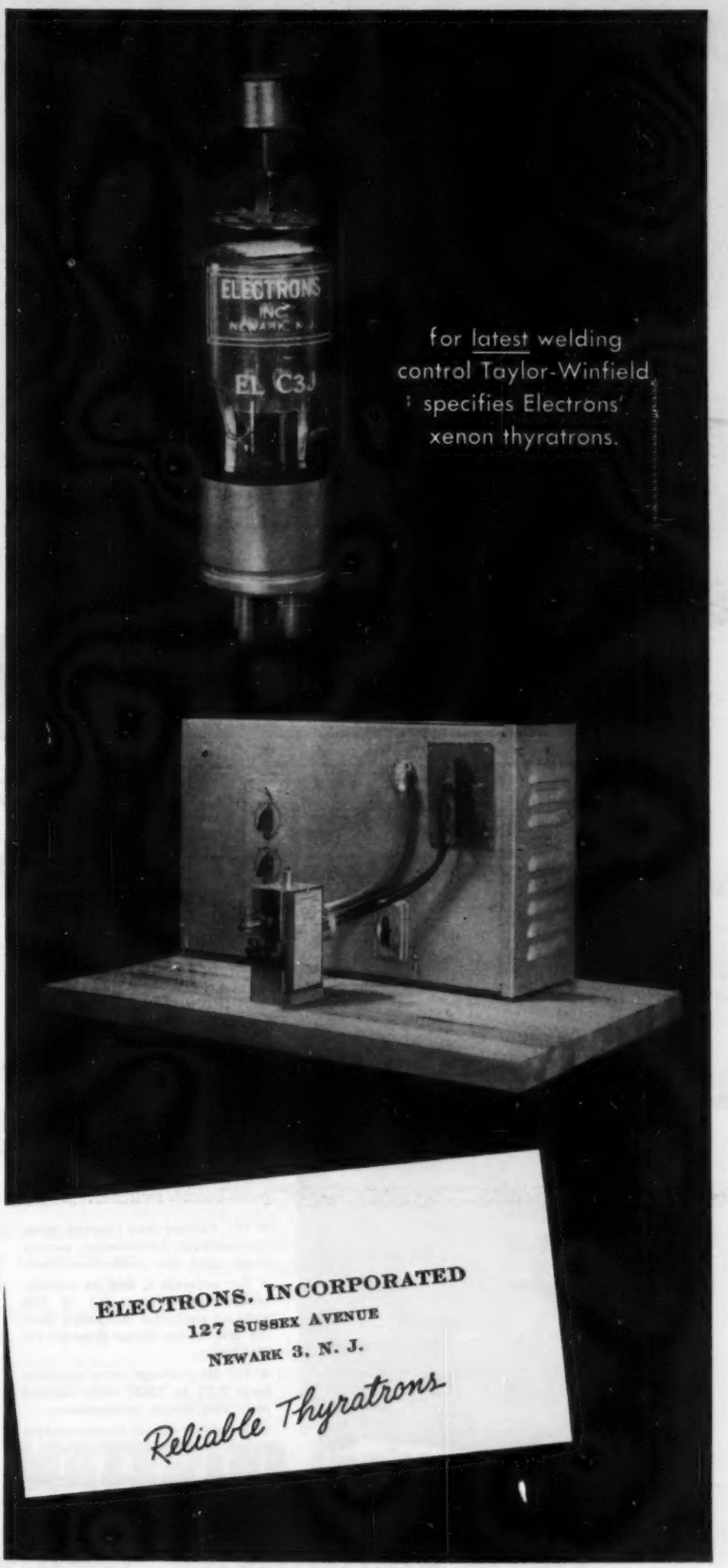
A new line of special-purpose contactors and relays, engineered and designed for the computer, power supply, and electronic industry is explained in a folder which will be of great interest to electrical engineers. In addition to the type *B* contactor, the types *R* and *F* relays are explained. **The Rowan Controller Co., 2313-2315 Homewood Ave., Baltimore 18, Md.**

Saturable Reactor Bulletin . . .

A bulletin describing proportioning reactors, transductors, switching reactors, and preamplifiers is available from Control, a Division of Magnetics, Inc. These are said to be the first standard lines of saturable reactors available to industry for reliable static control. Bulletin *C-15-S* shows the physical and electrical characteristics of the four product lines. **Control, A Division of Magnetics, Inc., Butler, Pa.**

Circuit Breaker and Enclosure Pocket Catalog . . .

Pocket Federalog *111-PR*, a handy, pocket-sized catalog giving price data on all products available from distributor stocks covers Stab-lok circuit breakers and enclosures, STABreakers and STABreaker enclosures, AB-I molded case circuit breakers, STABreaker panelboards, fusible service equipment, safety switches, industrial motor control, and lighting and power panelboards. Photographs and wiring diagrams illustrate these lines and accompany complete catalog information on prices, features, dimensions, ratings, and installation procedures. **Federal Pacific Electric Co., Department 303, 50 Paris St., Newark 1, N. J.**



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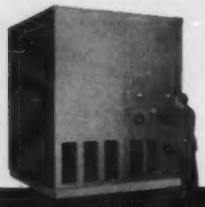

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Laboratory Standards

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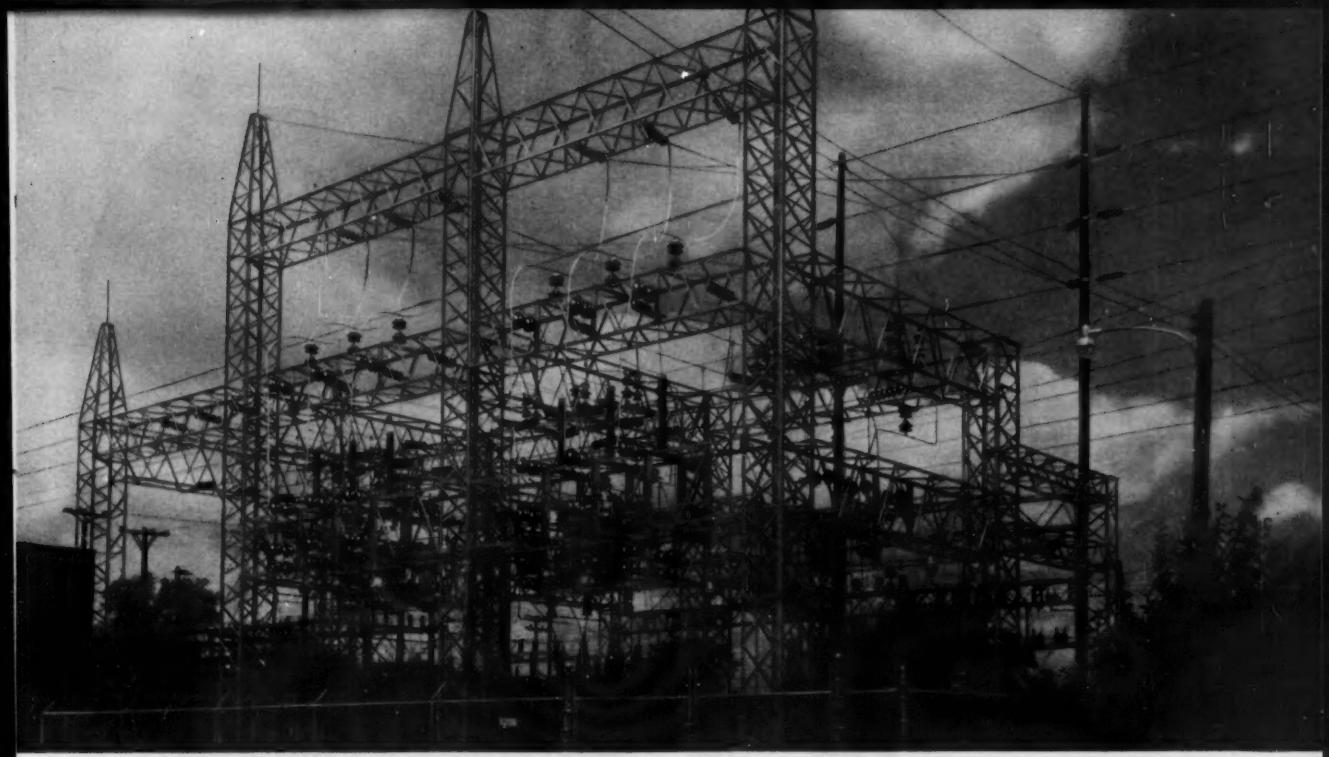
TWO INSTRUCTORS

for instrumentation courses in training school conducted by long-established, major instrument-manufacturer. Previous teaching experience desirable, with degree in physics or electrical, mechanical, or chemical engineering. Duties include organizing and conducting one-week to three-month courses, repeated several times yearly, for field-engineering trainees of company and for customers' instrument-technicians. Subject matter covers operating principles, construction, installation, and maintenance of indicators, recorders, controllers, and telemetering equipment for pressure, temperature, flow, liquid-level, etc.; self-balancing potentiometers and bridges; pneumatic and electric valves; etc. These are new jobs created because of steadily increasing demand for company's products and services. Salary is open and will be made definitely attractive to the right men. Write C. F. Johnson, Manager Education,

The Bristol Company,

Waterbury 20, Connecticut



LARGE URBAN-TYPE L-M PACKAGED SUBSTATION, designed by Line Material and erected in minimum time with L-M prefabricated steel. Incoming lines are 69 kv; outgoing are 7.2/12.47 kv. L-M engineers design these packaged stations in sizes from 5 to 161 kv, for industrial plants, and for rural and urban locations on utility company lines—all with completely coordinated plans, structure, and equipment.

L-M-Engineered Packaged Substations Save Planning and Construction Time

by W. V. SWAN, Product Manager
Substations and Power Switching Equipment
Line Material Industries

Line Material packaged substations offer wide choice of design and application; considerable flexibility and provision for future expansion; great savings in engineering and ordering for utilities. And, because of L-M's unique prefabricated steel structure, these substations are fast and easy to erect.

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Completely coordinated L-M substations need only one order; are delivered either as one shipment or coordinated to your construction schedule. It's easy to order an L-M substation. Just give us a one-line diagram of what you want—or tell us your voltage, kva requirements, number of incoming lines and outgoing feeders, and area available—and we'll design your substation for you!

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L-M's pre-engineered steel trusses and columns are completely prefabricated, and shipped knocked down or factory-assembled. Structures are steel, or aluminum alloy. Members have round holes punched at 3-inch intervals (before galvanizing) with square holes every foot. This eliminates measuring and drilling, and damage to galvanizing. Holes accommodate all bolts for lacing members and apparatus. That's why they go up so fast.

Prompt Shipment

Structural steel can be shipped in 3 to 4 weeks after final approval of order; complete stations in 4 to 12 weeks. Station design provides for easy, safe accessibility to all equipment. Stations meet NEMA, ASA and AIEE standards.

Ask the L-M Field Engineer for complete information and bulletins; or write Line Material Industries, Substation Department, Milwaukee 1, Wisconsin.

LINE MATERIAL Industries
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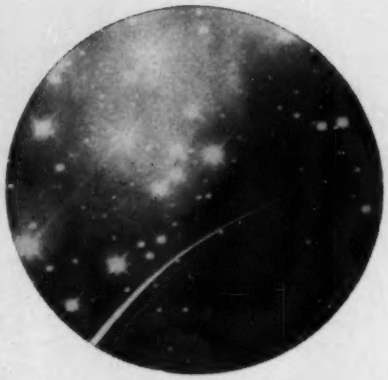
WHO CAN HELP YOU

...on page 21A



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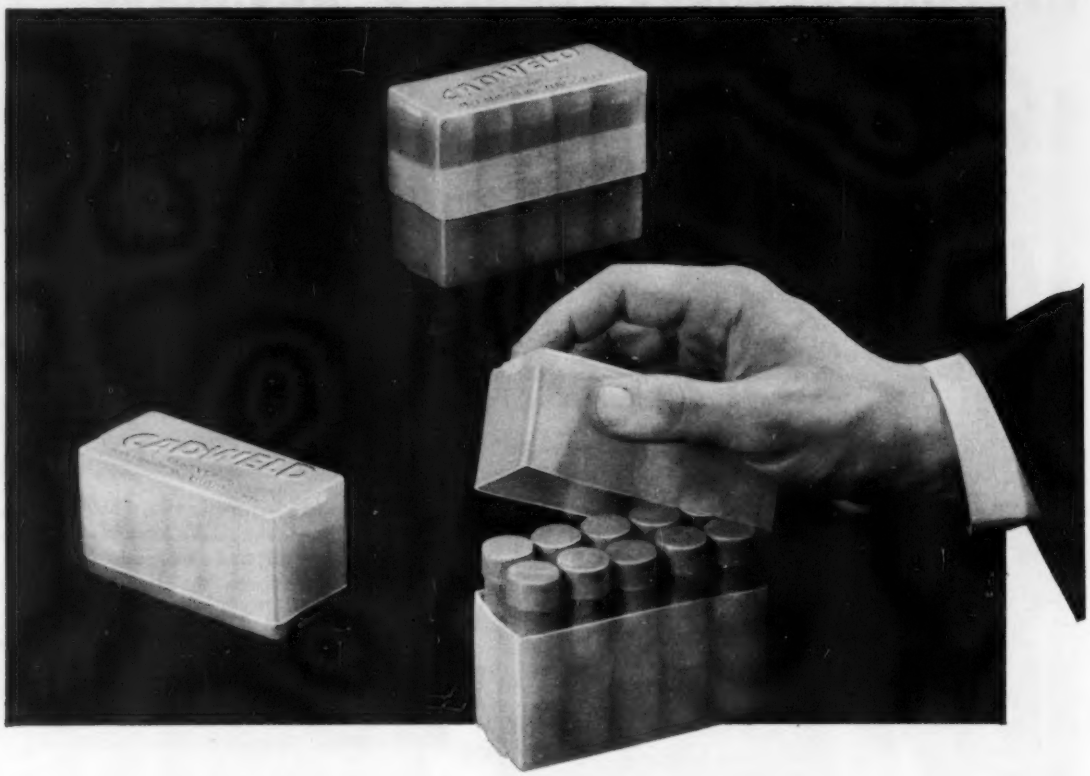

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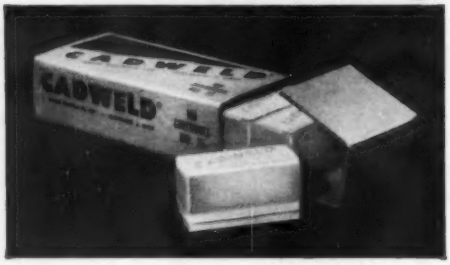

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Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

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DIRECTOR OF RESEARCH AND DEVELOPMENT, BME, BEE, PE; 41, five yrs electrical-mechanical development, 13 yrs steel mill plant engrg supv, three yrs nuclear engrg management. Heavy exper machine design, operation and maintenance. Cost control, proposals and customer relations. Nuclear research facility design and construction. E-130.

ELECTRICAL ENGINEER, 17 yrs exper. constr and maintenance; industrial, marine and power installations. Two and one half yrs foreign hydro. B.S. in E.E. Desire responsible position plant engr. Location desired: Domestic or Foreign. E-131.

ELECTRICAL ENGINEER, B.S.E.E., 33 Nine yrs exper sales, design, application engrg low voltage distribution systems, components including three yrs chief product engr. Desire responsible position product planning or management engrg with aggressive company. Location preferred: northern New Jersey, southern New England. E-132.

ELECTRICAL ENGINEER, B.E.E., 46, 22 yrs in supervision of elec des for petroleum, chemical and power plts. Also commercial, industrial and public bldgs. The work consisted of estimating, preparation of plans, specs, reports, purchasing, selling, stock control and supervision of installation. E-133.

ELECTRICAL AND MECHANICAL., B.Sc. Engrg, 28. Four yrs exper in England and North America in testing of transformers, motors and generators, and switchgear, design of H.V. switchgear and outdoor substations, including transmission lines. Location desired: preferably India or Ceylon area. E-134.

MANAGER QUALITY CONTROL, B.S.E.E., 46. 20 yrs power and electronic equipment, preparation of quality control programs, liaison with government or customer. Representatives evaluation of test findings, supervising inspection and test personnel. Location desired: New York, New Jersey, Connecticut or California. E-135.

Positions Available

TEACHING PERSONNEL. (a) Assistant, Associate or Professor, Ph.D. or Sc.D. in Power field. To teach senior and graduate courses in rotating machinery and direct these and research in this area. (b) Assistant, Associate or Professor, Ph.D. or Sc.D. in electronics. To teach senior and graduate courses in this area and direct theses and research in this field. Rank and salary dependent on experience and capability. Positions available June or September, 1959. Location, Midwest. W-6263.

ASSISTANT or Associate Professor in electronics, computers and servos. Prefer some industrial and teaching experience. Location, South. W-6513.

ELECTRICAL ENGINEER, for teaching position, power option, Ph.D. preferred; teaching and research duties. Rank and salary commensurate with qualifications and experience. Location, eastern Canada. F-7013 (a).

ELECTRICAL ENGINEER, Master's degree in electrical engineering, with experience in allied field desirable. Will study control requirements for thermo-electric systems; will also be involved with problems of transients, semi-conductors, circuitry and standard electrical studies and applications, i.e., electrical insulation, resistivity measurements and evaluation of electro-magnetic effects. Salary, $7500-$9000 a year. Location, New York State. W-7017.

SENIOR DESIGN ENGINEER, Electrical graduate, for a leading manufacturer of transformers (audio, power and pulse) filter networks, inductors, magnetic amplifiers, delay lines, etc. Will be responsible for design of transformers, power supplies magnetic amplifiers, delay lines and pulse forming networks. Must have experience in the above noted work areas; practical knowledge of drafting practices and procedures; general knowledge of production practices and equipment, methods engineering, production planning, etc. Salary, $9000-$12,000 a year. Location, northeastern New York State. W-7067.

ENGINEERS. (a) Transmission Tower Line Engineer, engineering graduate with electric utility design experience, to work on varied engineering problems dealing with complete transmission line design layouts, estimating line costs, engineering-economic studies and assisting in the specification and purchase of transmission line material. Salary open. (b) Relay Engineer, graduate electrical, with five years' engineering experience in utility protective relaying and automatic control generating and transmission stations; capable of network and stability calculations and transient analysis for application of relays and determination of relay settings. Salary open. Location, New York, N. Y. W-7068.

SENIOR ELECTRICAL DEVELOPMENT ENGINEER, B.S.E.E. required, M.S. preferred; to work on development and design of analytical instrumentation involving principles of pulse and digital circuitry and extremely high voltage power supplies. Must have a minimum of five years' instrument design experience with emphasis on pulse circuitry, regulated DC power supplies and involving evaluation of components such as vacuum tubes, counter tubes, relays transformers, etc. Salary, to $11,000 a year. Company will negotiate placement fees. Location. New York Metropolitan area. W-7082.

SENIOR ENGINEER for research and development on power conversion devices (power supplies AC to DC, invertors DC to AC, convertors DC to DC step up or step down), graduate electrical engineer or physicist, or equivalent experience in hardware end. Background in transistor applications, circuitry, magnetics or similar. Salary, approximately $12,000 a year. Location, Boston, Massachusetts area. W-7086.

SALES ENGINEER, Electronics, for manufacturers agent in the DC power supply field; some experience in the design and pricing of power supply. Some travel. Salary, $10,000 a year. Headquarters, Union County, New Jersey. W-7088.

(Continued on page 50)

SWITCHGEAR PLANT MANAGER

Graduate Engineer, early forties with minimum 10 years management experience in engineering and manufacturing phases of high voltage switchgear business, wanted to manage large switchgear plant of internationally known U.S. manufacturer of electrical distribution and control equipment. Unusual opportunity. Confidences respected. Send complete resume and salary requirements directly to company through—

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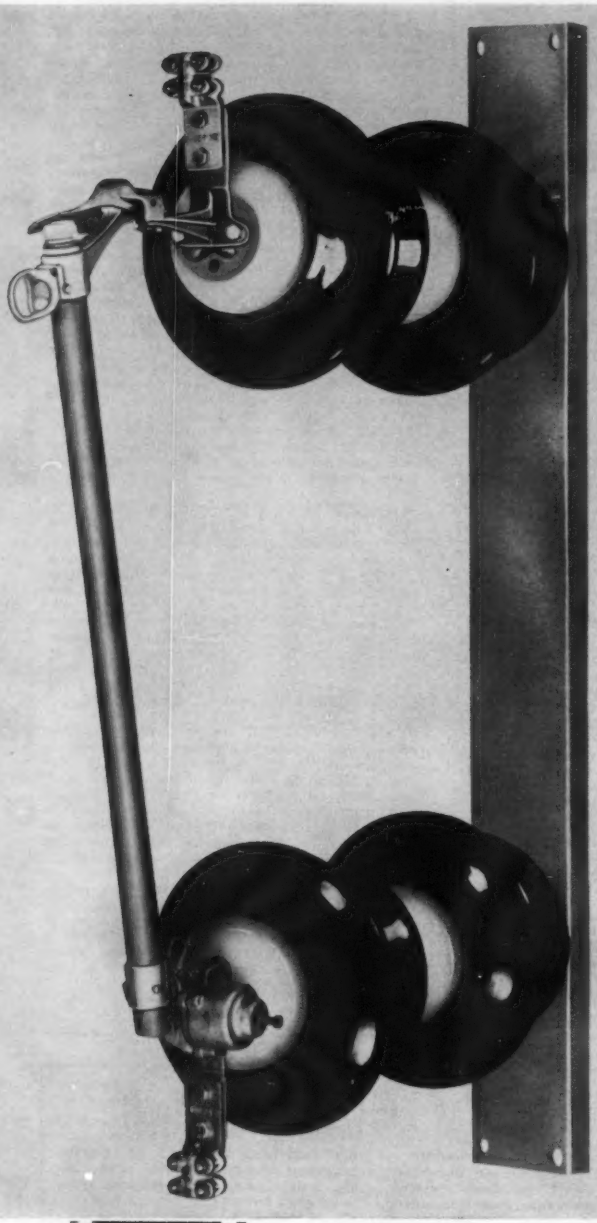

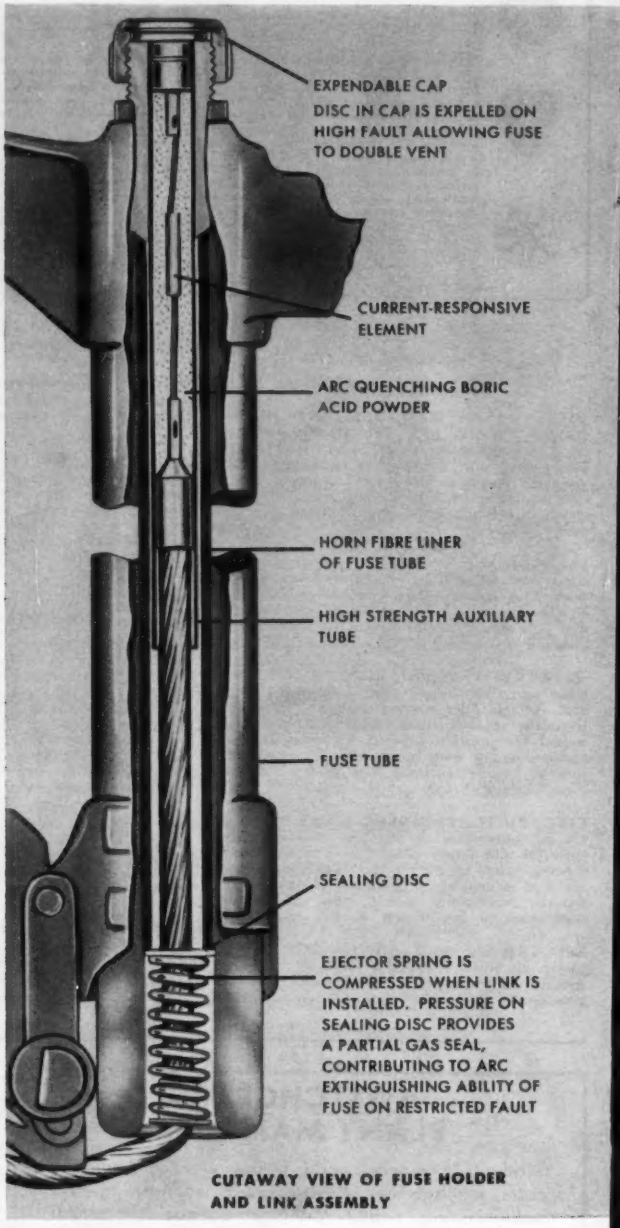
EXPENDABLE CAP
DISC IN CAP IS EXPELLED ON HIGH FAULT ALLOWING FUSE TO DOUBLE VENT
CURRENT-RESPONSIVE ELEMENT
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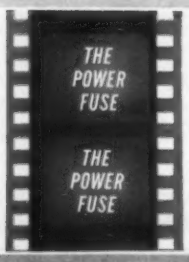
FUSE TUBE
SEALING DISC
EJECTOR SPRING IS COMPRESSED WHEN LINK IS INSTALLED. PRESSURE ON SEALING DISC PROVIDES A PARTIAL GAS SEAL, CONTRIBUTING TO ARC EXTINGUISHING ABILITY OF FUSE ON RESTRICTED FAULT

CUTAWAY VIEW OF FUSE HOLDER AND LINK ASSEMBLY



Don't miss this sound movie in full color..."The Power Fuse"

It is available, without cost, for viewing by anyone interested in power fuses. On-the-spot results of field tests conducted in conjunction with a leading utility. Factual, informative, well worth your time. Contact your Southern States representative to arrange a showing, or write direct to the company.

Power Fuses by Southern States

- POSITIVE CLEARANCE OF RESTRICTED FAULTS
- HIGHEST INTERRUPTING RATINGS AVAILABLE
- WIDEST RANGE OF SELECTION
- SIMPLIFIED CONSTRUCTION

Reliable performance—to provide dependable protection against high or low fault currents—is one of the most important requirements demanded of power fuses by engineers. With this uppermost in mind, we developed our new family of power fuses.

Extra reliability in clearing restricted faults is provided by the new, dual-operating characteristics of the expendable cap and arc-quenching boric-acid fuse link.

Extra reliability in handling high faults is provided by the double-venting action, fibreglass tubes and other design features—resulting in interrupting ratings approaching 3½-million kva at 161 kv.

A wider range of selection permits adequate fusing without buying excessive interrupting capacity.

The expendable cap and the sealing disc at the lower end of the fuse prevent the entrance of moisture or extraneous matter. Patented electrostatic shielding eliminates corona damage. A built-in snubber brings the fuse holder to a cushioned, shock-free stop. All in all, this rugged new family of power fuses is engineered to provide completely reliable service for many years.

Get the full story from your Southern States representatives, or write for Bulletin 59PF.

RE-FUSING IN THE FIELD IS QUICK WITH SOUTHERN STATES FUSE KITS

Economical fuse kits, with all of the components necessary for re-fusing in the field, are available for all Southern States Power Fuses. Four speed ratios—clearly marked, compact packages.

PIONEERS IN POWER FUSES SINCE 1924

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ENGINEERS

General Electric's Advanced Electronics Center *Announces* the construction of its new R&D Laboratory at Cornell University's Industrial Research Park

Equipped with most modern laboratory tools available and manned by one of the country's leading research and development teams, this new facility, on the shores of Lake Cayuga in Ithaca, New York, will be dedicated to advancing man's knowledge in areas of electronics that today lie beyond state-of-the-art barriers.

At the present time far-ranging programs in applied research and development work are being pursued in these important areas:

RADAR / INFRARED / DATA PROCESSING AND COMMUNICATIONS / HUMAN FACTORS ENGINEERING / ELECTRONIC COUNTERMEASURES / WEAPONS SYSTEMS SATELLITE AND MISSILE ELECTRONICS

The Advanced Electronics Center's rapid growth (from a small staff of less than a dozen eight years ago to a full complement of 380 today) is indicative of the accelerated career development that may be attained by working for G.E.

If you are a graduate engineer or physicist who has the imagination, training and experience to make major personal contributions to advanced programs in any of the above areas, ***write in strict confidence to: Mr. James R. Colgin, Advanced Electronics Center at Cornell University, Light Military Electronics Dept., Div. 27-MD.***

GENERAL ELECTRIC
Ithaca New York

Personnel Service, Inc.

(Continued from page 47A)

INSTRUCTOR or Assistant Professor to teach in electronics and control or machinery fields. Salary and rank dependent upon degree and experience. Research supervision with added pay. Excellent future. Salary, $7000 up. Location, South. W-7091.

ASSISTANT to Product Planning Manager, electrical or mechanical graduate, with some courses in design, accounting, economics and production control. Will consider recent graduate mechanical or electrical with additional courses in accounting or business administration. Experience as project engineer or project coordinator of new product development highly desirable, also data processing sales engineering or accounting. Salary, $7000-$10,000 a year. Relocation expenses and placement fee paid by company. Location, Connecticut. W-7100.

PROJECT ENGINEER, graduate electrical or mechanical, with experience in development and production engineering of electronic and electro-mechanical avionic devices, for company which manufactures and designs controls, timers, intervalometers, armament and ECM controls. Salary, about $11,000 a year. Location, New York, N. Y. W-7101.

LECTURER, to teach undergraduate level courses in electrical engineering; at least a B.S. degree but Master's preferred; Doctor's degree also desirable. Salary based on nine-month year; rank and salary open, depending upon degree and experience. Summer and evening sessions additional compensation. Location, New York Metropolitan area. W-7103.

DESIGN ENGINEER, graduate mechanical or electrical, with three to five years' experience preferably in missiles or aircraft systems. Salary, $10,000-$12,000 a year. Location, upstate New York. W-7106.

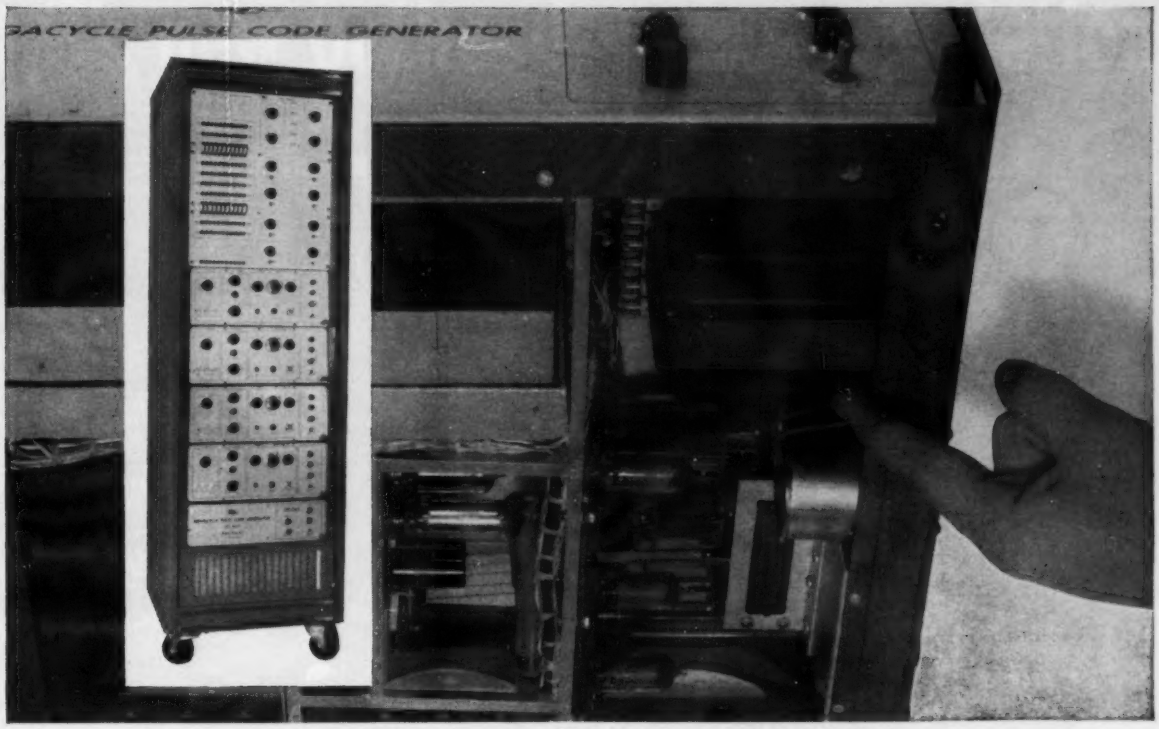
CHIEF ENGINEER, graduate electrical, with a minimum of five years' experience in the design of electric motors. Salary, $20,000 a year. Location, Midwest. W-7109.

PLANT MAINTENANCE ENGINEER, mechanical or electrical graduate, preferably with P.E. license, to supervise installation, operation and maintenance of air conditioning and power equipment. Must be citizen. Salary, $12,000-$15,000 a year. Location, Chicago area and eastern seaboard. W-7110.

TEACHING PERSONNEL for 1959-1960 academic year. (a) Mechanical Engineer, Heat Transfer. Rank and salary appropriate to qualifications. (b) Electrical Engineer, M.S. in E.E.; favorable consideration will be given to qualified younger man seeking opportunity to get started in a teaching career. Rank and salary dependent upon qualifications and experience. Location, New England. W-7115.

ENGINEERS. (a) Laboratory Manager for research in electronic chemistry and component materials; Ph.D. in physics or chemistry, with a minimum of ten years' experience in research and development of solid state devices. Should have a record of significant accomplishments and of responsible supervisory activity. Will be responsible for study and improvement of infrared detectors, research and development of improved infrared transmitting materials, study and development of evaporated films, etc. Salary open, liberal company benefits. (b) Infrared Scientist for Advanced Weapons Systems Analysis and Design; Ph.D. or D.Sc. in physics or electrical engineering required, direct research experience consisting of a minimum of ten years' experience in infrared weapons systems analysis and design; must know a progressively successful record of responsible positions. Will plan future infrared projects, conduct infrared technical advancement programs, carry out long range planning, etc. Salary open; liberal company benefits. Company pays placement fee. Location, suburban New York area. W-7119.

(Continued on page 52A)



Sola Constant Voltage Filament Transformer is an integral part of this Electro-Pulse, Inc. Megacycle Pulse Code Generator. It provides regulated filament voltage for reliable operation of the equipment and for full life of its electron tubes.

Sola transformer regulates filament voltage within ±1%--protects tubes from inrush currents and line transients

Fluctuations in supply voltage for electron tube filaments can be costly . . . in shortened tube life . . . in substandard performance . . . in equipment downtime. Electro-Pulse, Inc. solved its filament voltage problems through this straightforward approach: the company's Megacycle Pulse Code Generator includes a Sola Constant Voltage Filament Transformer built-in as part of its power supply.

This versatile unit does the step-down job of a conventional transformer and it also regulates the filament supply — a task that ordinary filament transformers don't pretend to do. Filament voltages are stabilized to within ±1% even with line voltage variations as great as ±15%. Its current-limiting characteristic protects tubes from cold inrush currents upon starting—as well as from line transients. It is a simple, reliable static-magnetic regulator with automatic and virtually instantaneous action. Variations in input voltage are usually corrected within 1.5 cycles. There are no tubes or moving parts, and no manual adjustment or maintenance is necessary.

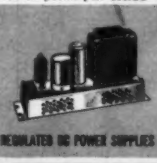
The filament voltage regulator illustrated is only one of a complete line of Sola Constant Voltage Transformers having wide application in electrical and electronic devices. They include such special types as harmonic-free, plate-filament, and adjustable output units—all provide the benefits of regulated input voltage. More than 40 ratings of these compact, economical regulators are available from stock, and Sola manufactures custom-designed units (in production quantities) to meet special needs.

For complete data write for Bulletin 5D-CVF-269

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill., Bishop 2-1414 • Offices in principal cities • In Canada, Sola Electric (Canada) Ltd., 24 Canmotor Ave., Toronto 18, Ont.

SOLA

CONSTANT VOLTAGE TRANSFORMERS


REGULATED DC POWER SUPPLIES

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QUO VADIS?

Where are you going . . . as an engineer and a person? Are you standing still . . . or falling behind? (They are one and the same.) If you have the qualifications for leadership in the electronics field . . . you should investigate the opportunities open within the select circle at Westinghouse-Baltimore. Write today for details on where Westinghouse-Baltimore is going and what lies ahead for you with this engineer's company.

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BALTIMORE

WESTINGHOUSE W

Personnel Service, Inc.

(Continued from page 50A)

ENGINEERS, (a) Test Design Equipment Engineers, with a minimum of five years' experience in designing test equipment for commercial and military laboratory and field applications. (b) Antenna Engineer to advise on antenna aspects of new system proposals and projects; design, develop and evaluate antenna elements and systems. (c) Circuit Engineer, RF, to design and develop RF amplifiers, IF amplifiers, etc. (d) Systems Engineer for planning and developing navigation, traffic-control and communication systems. Salaries open, liberal company benefits. Company will pay placement fees. Location, New York suburban area. W-7120.

ENGINEERS, (a) Staff Engineer. Railroad Products, with a minimum of eight years' experience in project development and staff supervision. Should be well versed in electronic systems with emphasis on analog and digital computer techniques. (b) Senior Development Engineer, Railroad Projects, for design, development products such as speed recorders, shunting aids, gate crossing protection, etc., to improve present performance. Salaries open, liberal company benefits. Company pays placement fees. Location, New York Suburban area. W-7121.

SITE MANAGER, electrical graduate, with at least ten years' administrative and supervisory experience covering installation and operation of complex electronic communication equipment. Must be familiar with military specifications, regulations and accounting practices. Salary, $15,000-$20,000 a year, plus extras. Location, Greenland. F-7125.

CHIEF ENGINEER with extensive experience in microwaves and wave guides for small manufacturing company in this field. Salary, $15,000-$20,000 a year. Location, Massachusetts. W-7140.

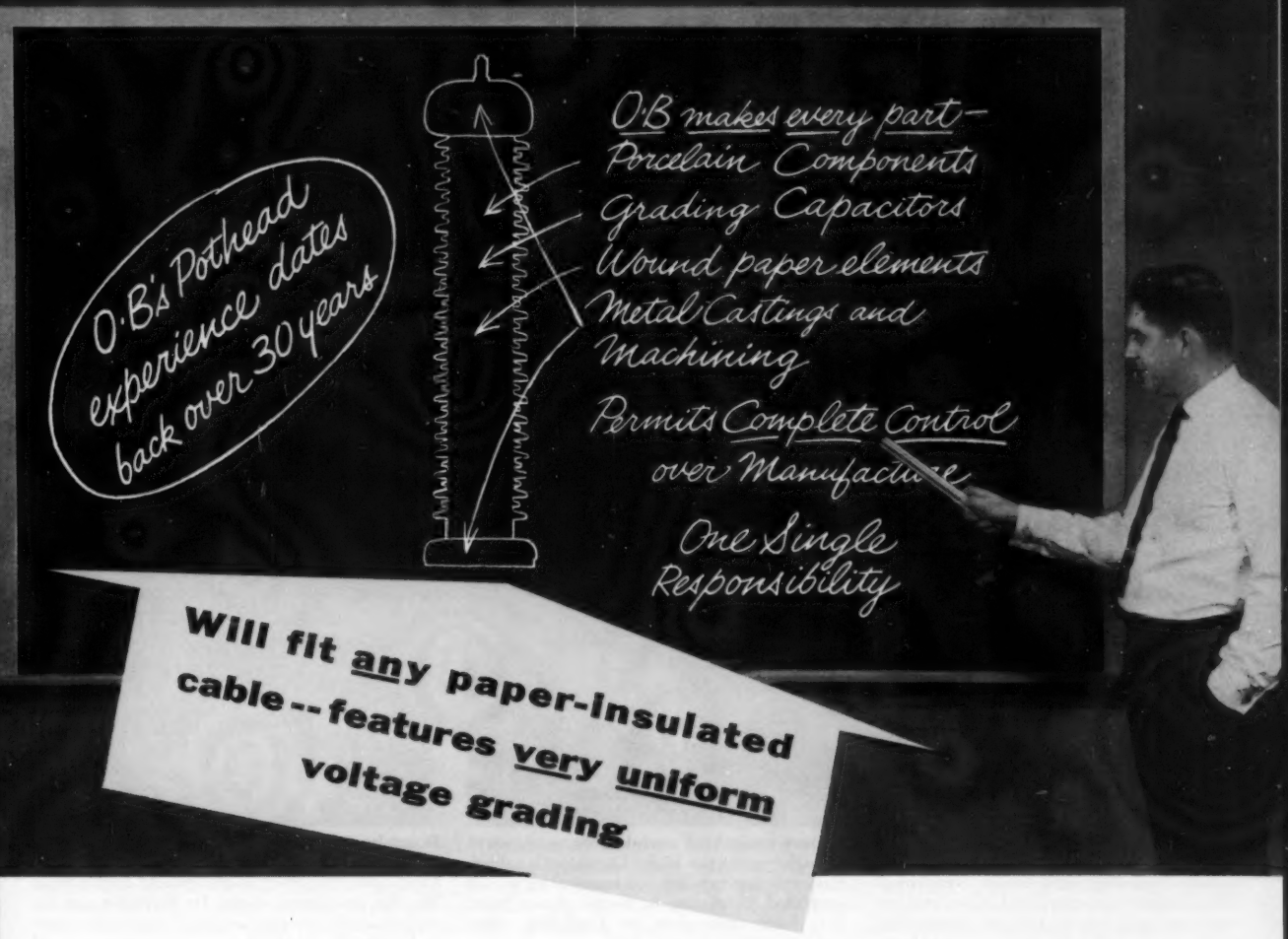
TECHNICAL SALES ENGINEER, graduate electrical or metallurgical engineer preferred, with a minimum of two years' practical engineering experience. Should, preferably have some sales training. Following a period of in-plant training, will be employed in technical sales of aluminum products used as an electrical component by leading manufacturers. Salary, $8000-$12,000 a year depending on experience; excellent opportunities for advancement. Considerable travel. Must be willing to live in the East, Midwest or South as designated by the company. Headquarters, Connecticut W-7142.

TEACHING-RESEARCH, full year appointments available. Research needs presently in field electronic counter-measures with other field possible. Teaching in new undergraduate program with strong engineering science emphasis and E.E. graduate, (MS) program. M.S. or Ph.D. required. Nine months' salary range presently $5000-$9000. Arrangements can be made for combined teaching-research or for full research or teaching alternate semesters or years. Location, Kansas. C-7263.

ENGINEERS, (a) Electronics Engineer, B.S.E.E., with five or more years' experience. Responsible for organizing and setting up electronics type laboratory to develop certain special products in the field of instrumentation and control. Responsible for employee and supervisor model makers and technicians. Should be familiar with sheet metal shops and electronics laboratories to specify type of equipment required. To design simple electronic devices such as magnetic amplifiers, regulators, some electrical alarm circuits, etc. Provide consultation to design groups in field of regulators and controls for rotating machinery; particularly as it is applicable to aircraft and missile range. Salary, $10,000-$12,000 a year. Employer will pay placement fee. Location, South Wisconsin. (b) Designer-Electronic Circuits, B.S.E.E., with eight or more years, in electronic circuit design with recent experience in transistor application as it pertains to transistor power supplies and digital techniques, perhaps in the numerical machine tool line or data

(Continued on page 62A)

O-B's new pothead nears completion



Will fit any paper-insulated cable--features very uniform voltage grading

You'll hear more about the new O-B pothead very soon. It will work with any kind of paper-insulated, oil-impregnated cable. Capacitors within the relatively small porcelain casing give it uniform internal grading. Installation is simplified and materially speeded-up. Cable end exposure during construction is minimized. These potheads will be available for all voltages of 115 kv and above, and for both low and high pressure systems.

Furthermore, every part of this new O-B pothead comes from *one manufacturer* -- one overall responsibility, plus detailed technical control over even the smallest item. Only O-B, with its complete production facilities in high voltage porcelain, metal-working, paper-winding, and capacitor manufacture, can offer such an obvious advantage.

If you anticipate installation of underground high voltage cable, please give us the opportunity to discuss your terminal requirements with you. We think you will agree it will be to your advantage.

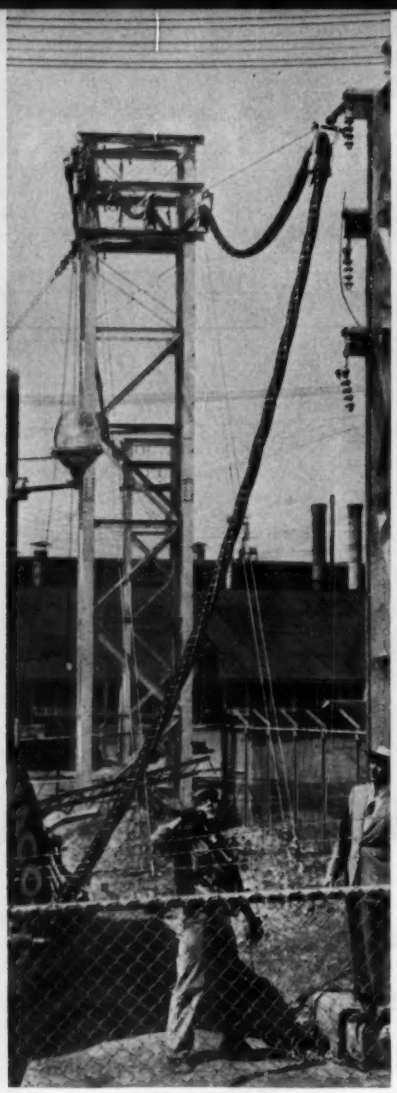
OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass HOLAN

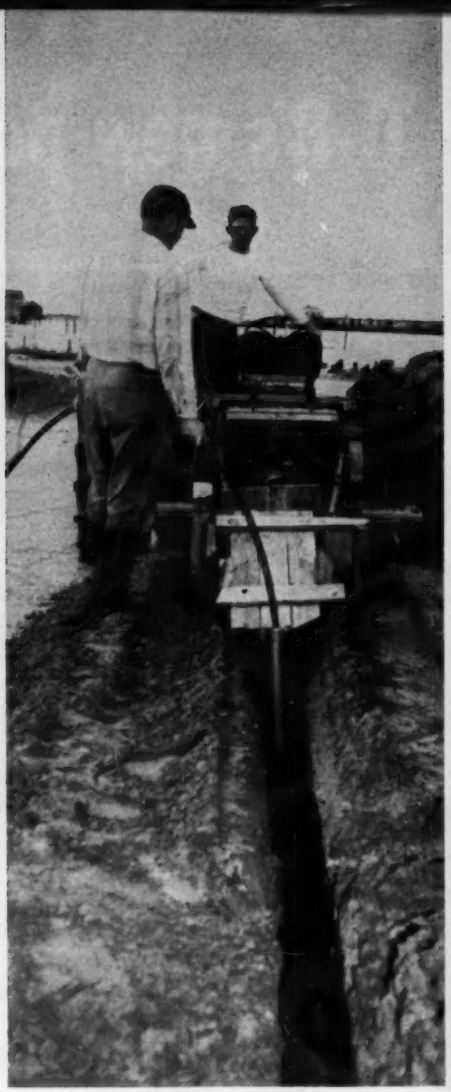
PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

4924-H1

Quickly installed aerial cable. Here's an application where 600-volt Durasheath was quickly installed and easily terminated. Durasheath's neoprene jacket resists weather, abrasion, heat, fumes. Assured: dependable performance and long-range economy!



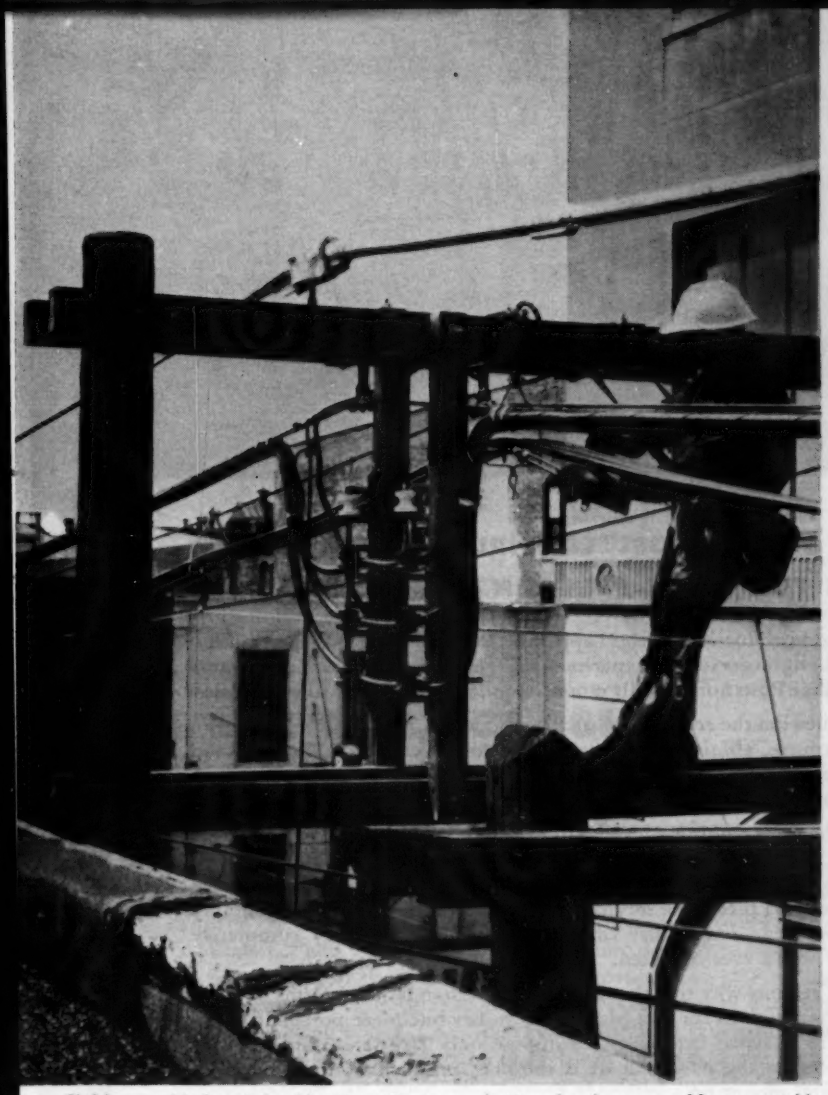
Factory-assembled aerial cable, made up of 3 single-conductor 15-kv Durasheath cables. Easy splicing, tapping and terminating meant simplified installation in the job shown here. No ducts, crossarms or insulators were needed. Wiring is neat, safe.



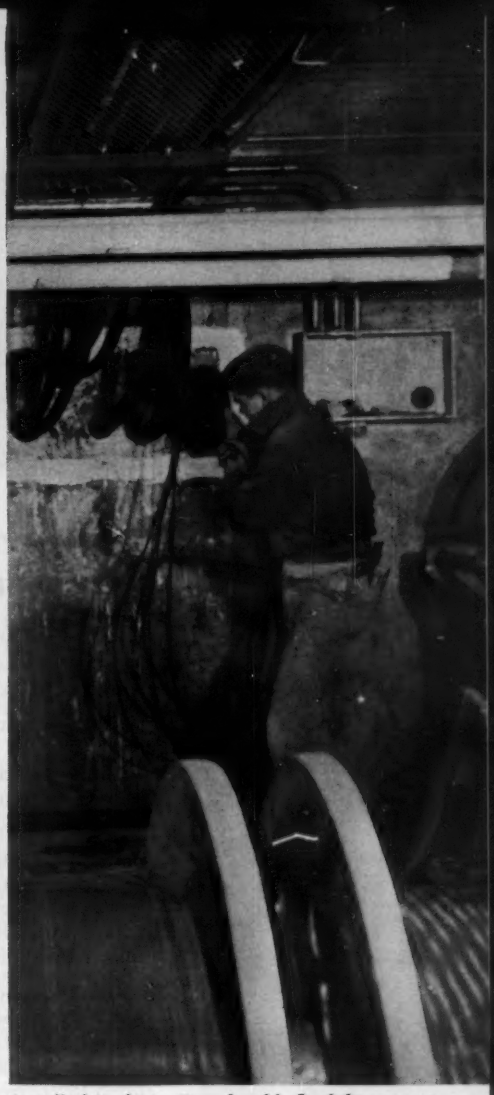
Direct-burial cable. The moisture-, oil-, and acid-resistance of Durasheath's jacket makes it the ideal cable for direct-in-the-ground applications like the one shown above. Its flexibility cuts installation time and cost because Durasheath is easy to handle. Its durability cuts maintenance costs!

Look at the ways you can save installation time and cost—with dependable Anaconda Durasheath Cable!

Wherever you want . . . whenever you want—this versatile power cable lets you install circuits fast . . . easily . . . at low cost! Use it aerially . . . in ducts . . . underground—in long runs with minimum splicing, indoors or out!



Field-assembled aerial cable. Versatile Anaconda Durasheath power cable was quickly field-assembled into aerial cable with the simple spinning operation shown here. Additional Durasheath was run along the building, grouped in a neat assembly by insulators and straps. It's another example of the way dependable Anaconda Durasheath adapts itself to your power cable needs—whether indoors, outdoors or both. Check into Anaconda Durasheath power cable for your wiring plans!



Installed in ducts. Durasheath's flexibility meant quick and easy installation here. And once installed, its tough neoprene jacket assures long, trouble-free life. Because Durasheath adapts itself to so many uses, your inventory problems are lessened—fewer cables need be carried in stock!

The installations shown above have one thing in common: they're all using Anaconda Durasheath* rubber-insulated neoprene-jacketed power cable —each for a different *kind* of application! Although the above photographs were taken at different installations, they could very well be pictures from one and the same job. Versatile Durasheath is a power cable that can be used to meet almost *any* installation need!

Such versatility in the use of Durasheath enables you to plan the most efficient layout for your wiring – then carry these plans through economically, with assurance of reliability. Talk to the Man from Anaconda about Durasheath. For full information, write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

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ANACONDA DURASHEATH ALL-PURPOSE POWER CABLE
Available in all sizes, single and multiple conductor, copper or aluminum, 600 to 15,000 volts and higher.

Insulation. Type RHW, Anaconda ANW, AHW or butyl rubber compounds, each designed for specific purposes.

Jacket. Specially compounded neoprene with high resistance to flame, oil, acids, alkalies, sunlight and ozone. Has high tensile strength. Takes flexing at extremes of temperatures.

SEE THE MAN FROM

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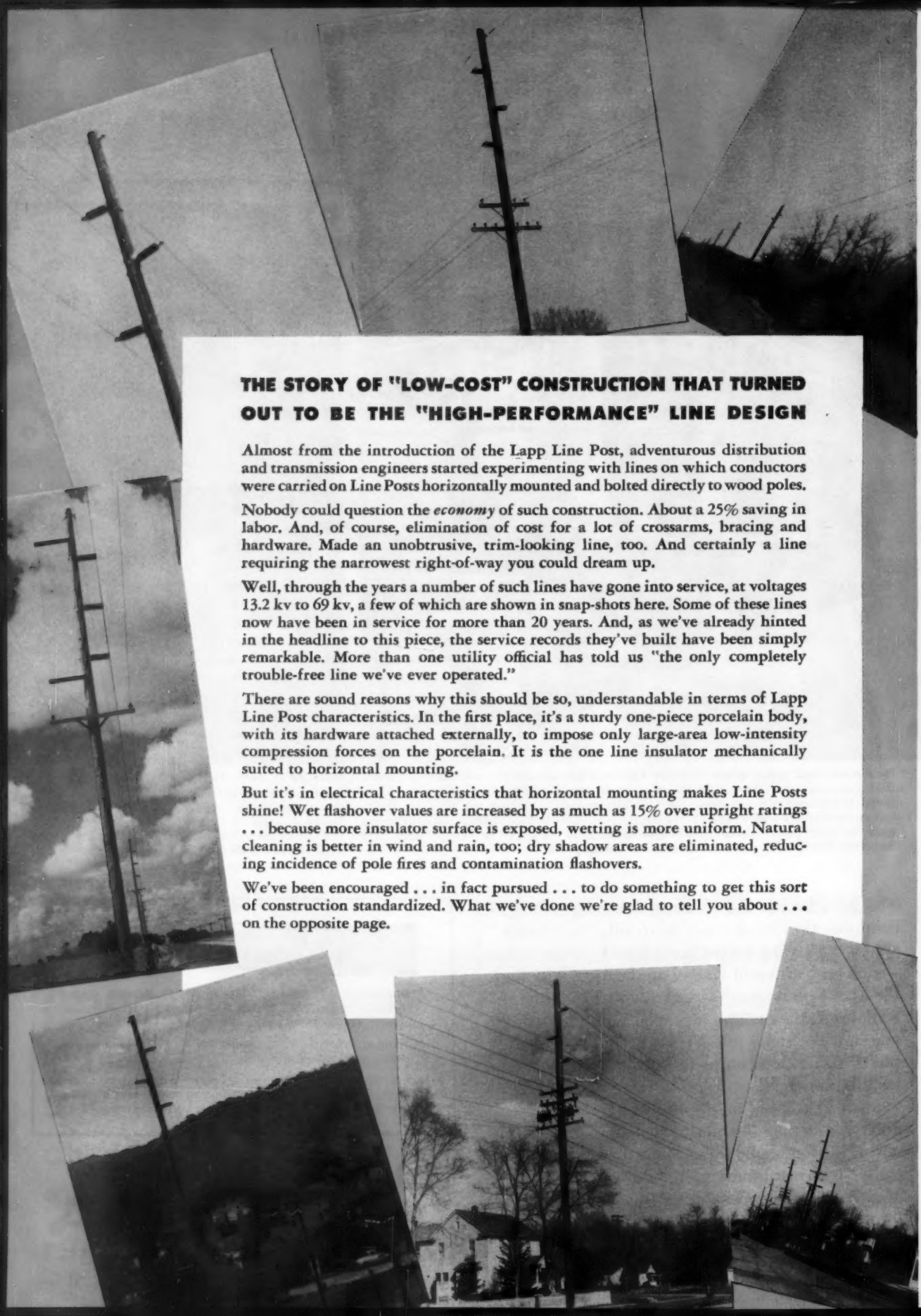
FOR DURASHEATH CABLE



THE STORY OF "LOW-COST" CONSTRUCTION THAT TURNED OUT TO BE THE "HIGH-PERFORMANCE" LINE DESIGN

Almost from the introduction of the Lapp Line Post, adventurous distribution and transmission engineers started experimenting with lines on which conductors were carried on Line Posts horizontally mounted and bolted directly to wood poles.

Nobody could question the *economy* of such construction. About a 25% saving in labor. And, of course, elimination of cost for a lot of crossarms, bracing and hardware. Made an unobtrusive, trim-looking line, too. And certainly a line requiring the narrowest right-of-way you could dream up.

Well, through the years a number of such lines have gone into service, at voltages 13.2 kv to 69 kv, a few of which are shown in snap-shots here. Some of these lines now have been in service for more than 20 years. And, as we've already hinted in the headline to this piece, the service records they've built have been simply remarkable. More than one utility official has told us "the only completely trouble-free line we've ever operated."

There are sound reasons why this should be so, understandable in terms of Lapp Line Post characteristics. In the first place, it's a sturdy one-piece porcelain body, with its hardware attached externally, to impose only large-area low-intensity compression forces on the porcelain. It is the one line insulator mechanically suited to horizontal mounting.

But it's in electrical characteristics that horizontal mounting makes Line Posts shine! Wet flashover values are increased by as much as 15% over upright ratings . . . because more insulator surface is exposed, wetting is more uniform. Natural cleaning is better in wind and rain, too; dry shadow areas are eliminated, reducing incidence of pole fires and contamination flashovers.

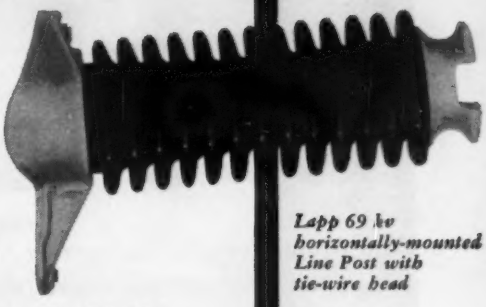
We've been encouraged . . . in fact pursued . . . to do something to get this sort of construction standardized. What we've done we're glad to tell you about . . . on the opposite page.

Entire structure is easily assembled on the ground before erection

Lapp 69 kv horizontally-mounted Line Post with trunnion conductor clamp

and now...

LAPP LINE POSTS SPECIFICALLY DESIGNED FOR HORIZONTAL MOUNTING



Lapp 69 kv horizontally-mounted Line Post with tie-wire head

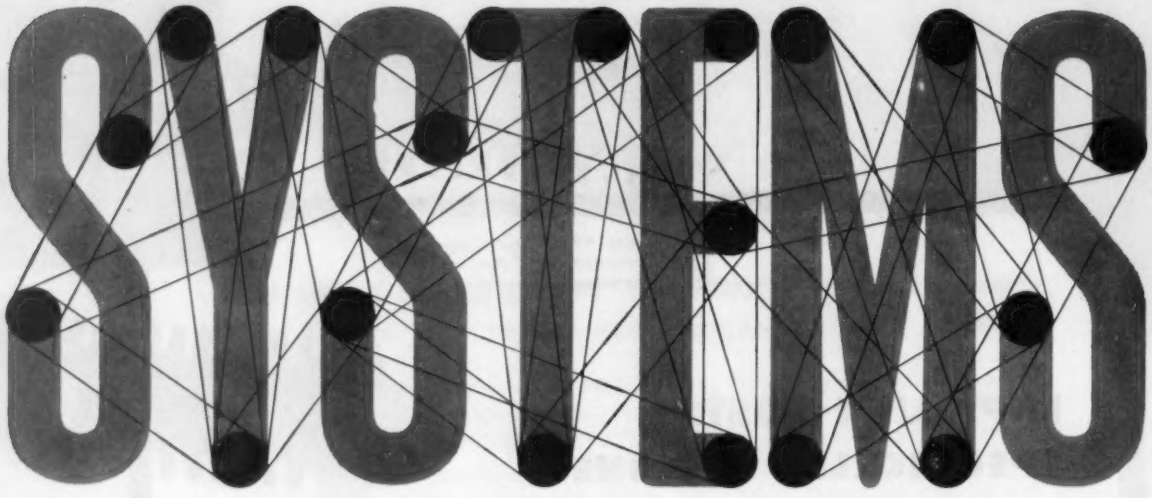
A new series of Lapp Line Posts for horizontal mounting is now offered in six voltage ratings: 35 kv, 45 kv, 55 kv, 66 kv, and 88 kv. The bases are malleable iron castings with a mounting radius which will provide maximum contact to Class 1, 2 and 3 poles. Insulators are bolted directly to the pole by bolts at top and bottom of the base. This design provides that full cantilever strength of the insulator be developed with little deflection, and without failure of pole or mounting bolts. (Compare this with typical crossarm construction, where failure of braces or splitting of crossarm would occur at a value far less than the 2800 lbs. for which the insulator is rated.) In addition, longitudinal loading is possible at a value at least 50% more than can be withstood by crossarms. This extra strength permits use of longer span lengths, larger conductors and greater factors of safety.

By use of a simple outrigger shield wire and ground wires, it is practical and economical to achieve a structure flashover value with horizontally-mounted Line Posts greater than that of a typical wood-crossarm wood-brace vertical insulator assembly . . . with no possibility of wood burning or splitting. This is explained in Lapp Data Sheet No. 539, a copy of which is yours for the asking.

Lapp

LAPP INSULATOR CO., INC., LE ROY, N. Y.

You can explore new areas at IBM in



Electronic systems engineering covers the full spectrum of applied research and development at IBM. With this broad, flexible range, and IBM's outstanding resources and facilities, your own imagination and creativeness will find unusual opportunity for expression. Currently, IBM engineers and scientists concerned with broad systems problems in business, science and government are working toward self-optimizing computers. These computers may someday program themselves and arrive at the one best solution to a problem. Digital computers are being applied to simulate all the problems of a business firm operating under specified economic and statistical conditions. Progress is being made in advanced studies for radically different data systems for terrestrial and stellar navigational problems. For problems like these, and many others, IBM needs people who want to convert challenges into careers.

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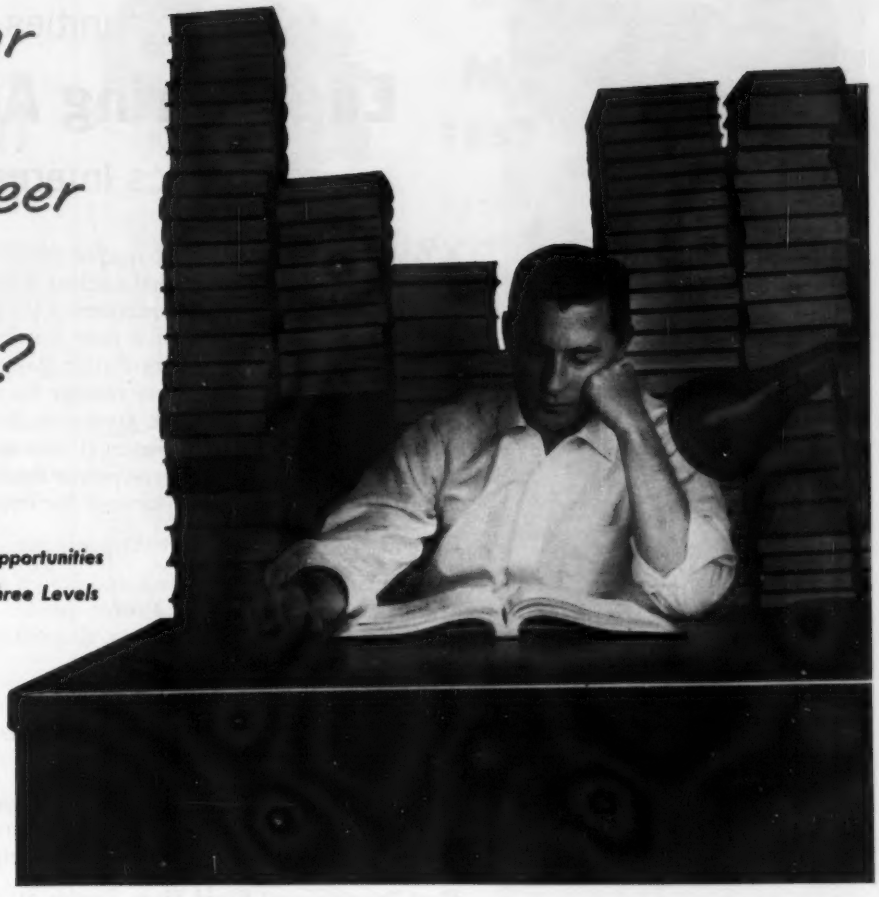

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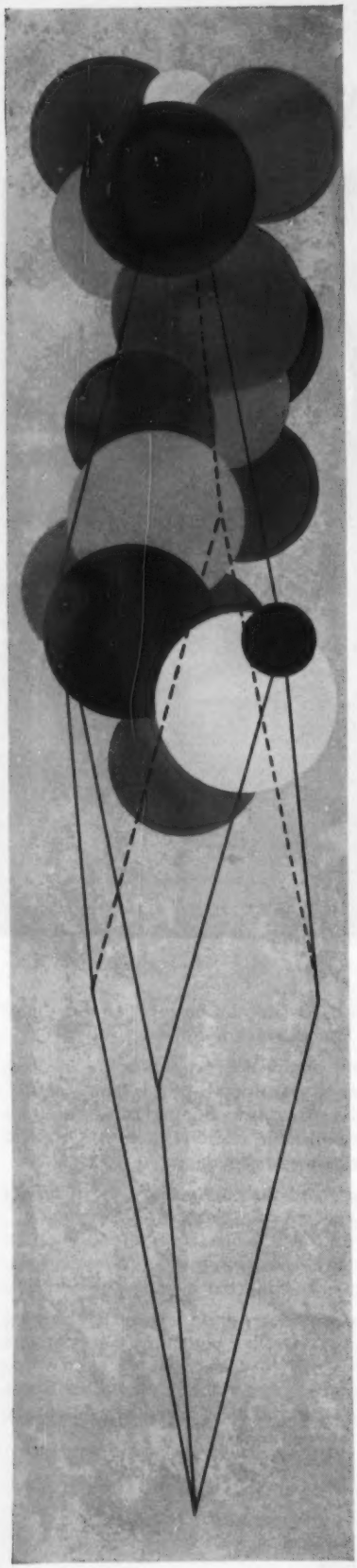

Opportunities in

Engineering Analysis

at Atomics International

A fast-growing backlog of major projects is creating future-assured openings for qualified nuclear scientists and engineers at Atomics International headquarters in the suburban San Fernando Valley near Los Angeles. AI is now developing a Sodium Reactor power station for Consumers Public Power District of Nebraska and an advanced type of power reactor for a group of fifteen utility companies in the Southwest. Overseas, five AI research reactors are in operation or under construction—and AI's Organic Moderated Reactor is one of the three power reactor concepts the Atomic Energy Commission has approved for export to Euratom.

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Write today for more details about exciting career opportunities: Mr. E. D. Newton, Personnel Office, Atomics International, 21600 Vanowen Street, Canoga Park, California.

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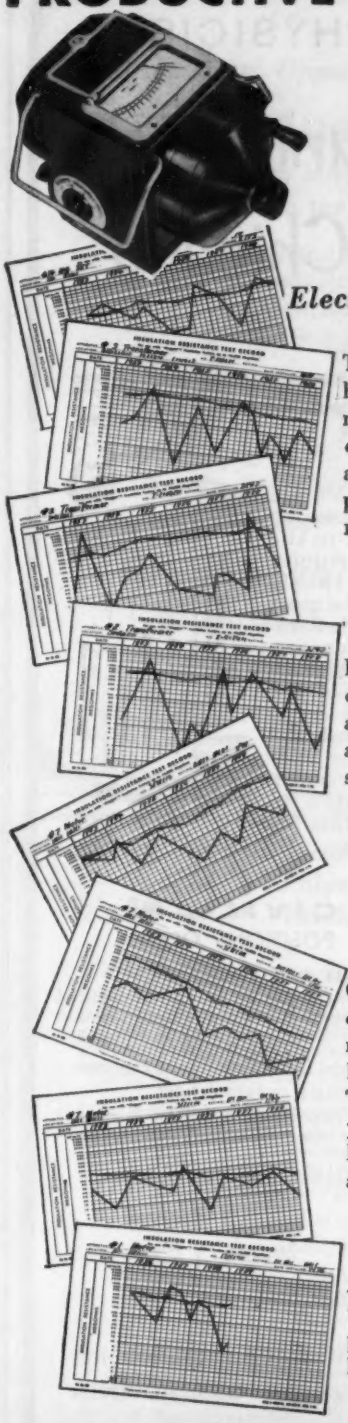

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(Continued from page 52A)

processing field. Salary, $10,000-$12,000 a year. Employer will pay placement fee. Location, South Wisconsin. C-7267.

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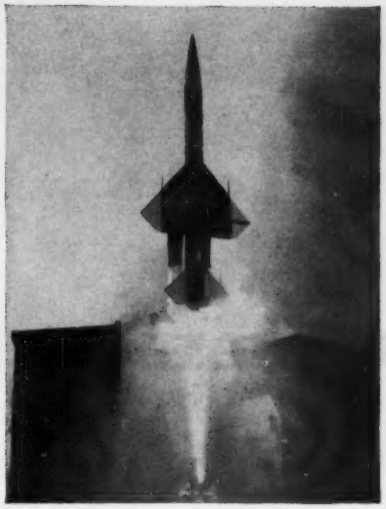
UTILITIES ENGINEER, electrical, E.E. or equivalent, experience with small utility (power purchased, 2000 customers—130 miles of transmission and distribution lines, 60 KV to 712 KV.) Able to layout and draft transmission lines and substation; should know metering, billing and invoicing; able to handle pay and costs, prepare charts and graphs and check materials, construction and maintaining; able to take over as manager in year or two for a municipality. Desire Western man. Salary, to $8400 a year. Location, Nevada. S-4135.

DESIGNER, Electric Light and Power; Should be E.E. or equivalent, with five to ten years' good experience in electrical consultant's office preparing plans, specifications, wire diagrams for small commercial buildings, schools and small industrial plants; heavy on commercial lighting design and specifications; knowledge of fixtures, lighting requirements and arrangements plus esthetic sense in selecting appropriate fixtures and making line and detailed wire diagrams for complete electrical wire system including light and power load distribution, panels, conduit and wiring. For consultant. Salary, $8400 a year. Location, Santa Clara County. S-4143.

JUNIOR ENGINEERS, Manufacturing Plant, E.E. or M.E., married and congenial for small isolated community, to be trained for supervisor or executive position with large national manufacturer of building materials. Salary, $5700 a year, if without experience, or better if experience warrants. Location, Southern California. S-4150.

ELECTRICAL DESIGNER, Industrial, Commercial, E.E., with California license. Must be experienced on heavy industrial and commercial wiring installation; for electrical contractor. Salary, about $7200 a year to start. Location, San Francisco. S-4176.



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- Thermal Embrittlement of the More Crystalline Polyethylenes
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- Use and Performance of Polyethylene Power Cable in Chemical Plants
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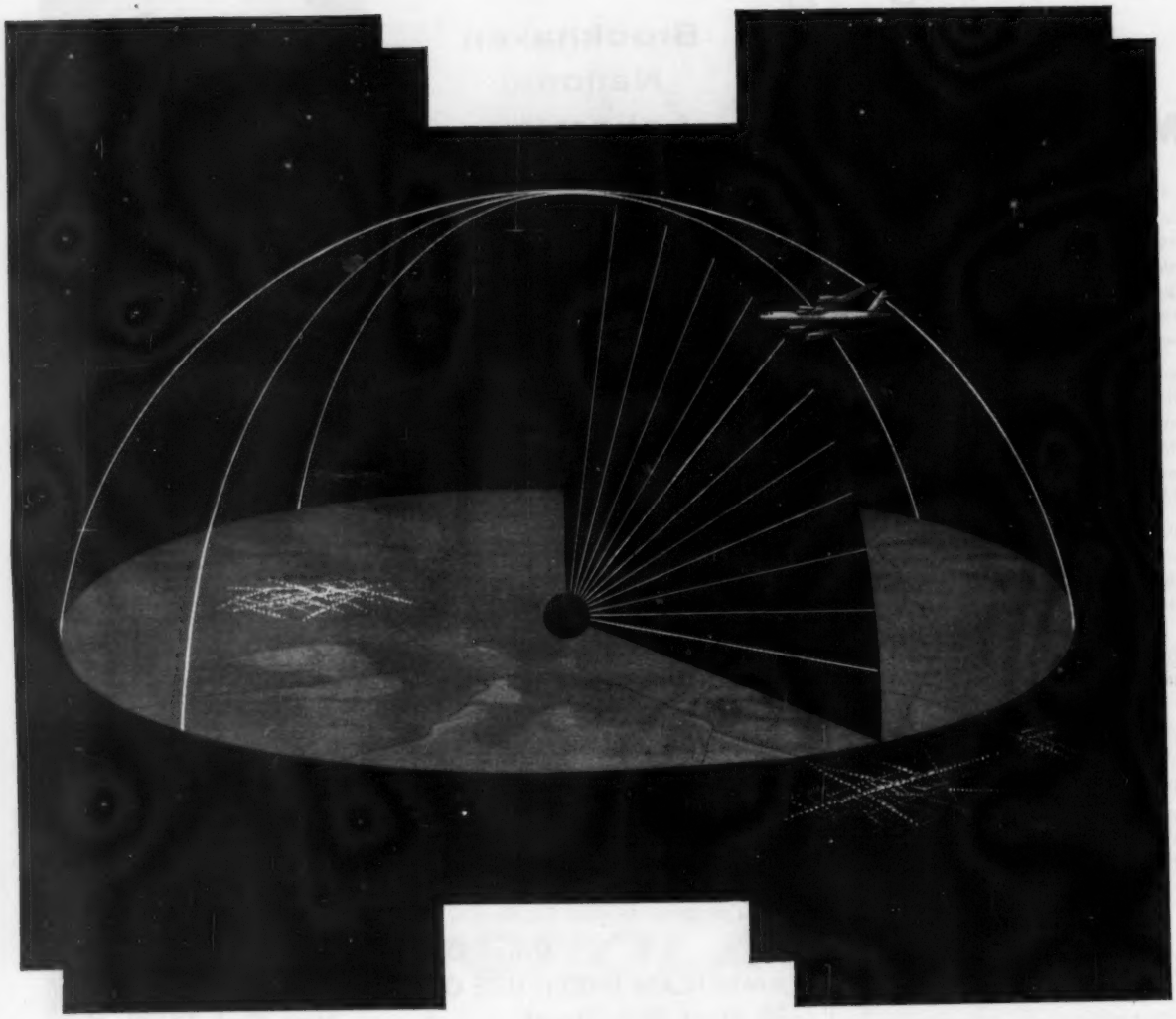


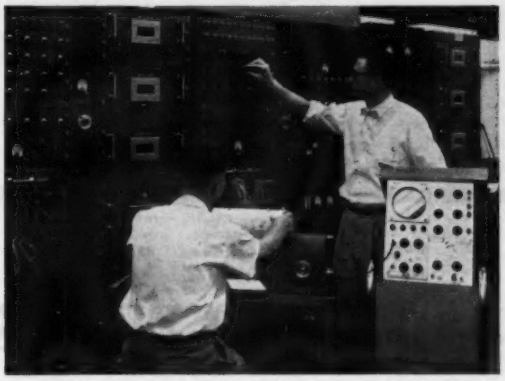
THAT NEVER LEAKS

To achieve umbrella-like radar protection Hughes engineers at Fullerton, California, have developed systems which position radar beams in space by electronic rather than mechanical means. These unique three-dimensional radar systems are digitally programmed to instantaneously detect high-speed enemy aircraft, even at low altitude.

Other defense systems under development at Hughes in Fullerton are Data Processors which monitor the movement of hundreds of aircraft, store the information and assign defense weapons; radars with beams capable of detecting and tracking missiles; and new radar systems for installation on surface and subsurface naval vessels.

Other Hughes activities are delving into similarly advanced areas of electronics. Engineers at Hughes Research & Development Laboratories are probing into the effects of nuclear radiation on electronic equipment, studying advanced microwave theory and applications, and examining communication on a spatial scale. Applying this advanced type of creative engineering to commercial projects is the task of engineers at the Hughes Products activity.

The highly advanced and diversified nature of Hughes projects offers creative engineers and physicists the opportunity to build a rewarding career in a progressive and expanding environment.



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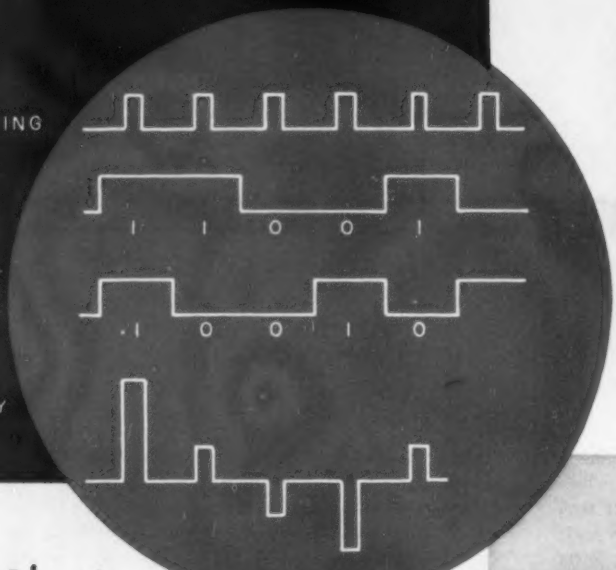
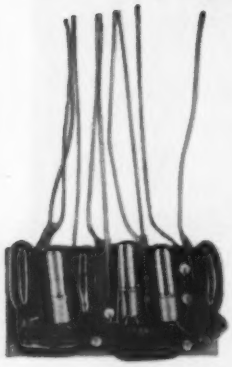
PULSE CODE MODULATION

PCM is a new method of coding voice and analog information into digital form. It provides a completely digitalized message by time-division multiplexing of voice circuits. Adaptation of the technique offers advantages in signal-to-noise characteristics, signal regeneration, message security and equipment reliability not usually achieved with conventional techniques.

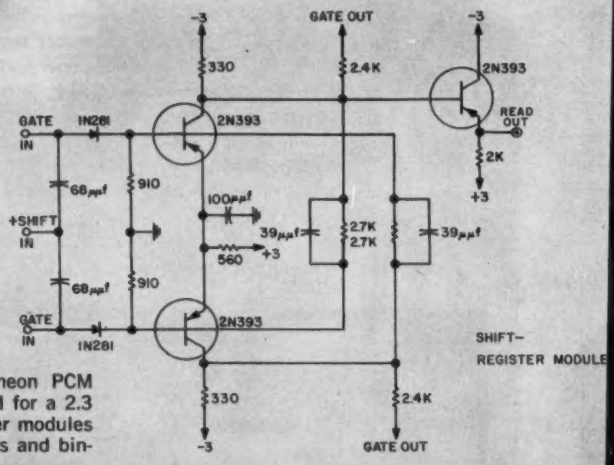
A 96-voice channel, fully transistorized PCM equipment for cable and radio transmission meeting rugged military requirements is now being developed by the Communications Department of Raytheon's Government Equipment Division. In this system a sampling frequency of 8,000 cycles is used. Each sample is coded in six-bit binary form, at a bit frequency of 4.6 mc. Many new circuit techniques, closely allied to high-speed data processing and computer systems are being developed for this equipment.



THE QUATERNARY WAVE combines information from trains 1 and 2, and the timing pulse regulates the width and position of the quaternary output wave. Thus, twice as much information is passed through the same bandwidth as is required for one train.



TYPICAL MOLDED MODULE used in Raytheon PCM equipment comprises logic circuitry required for a 2.3 mc shift register shown in the diagram. Other modules are used for repetitive and-or gates, flip-flops and binary-storage elements.



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CORRECTION

In the March 1959 issue of *Electrical Engineering*, page 46A, the request for back copies of January 1959 should read January 1958. See ad below.

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c. 440 pp, 265 illus, 1959—$8.50

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By WILFRED KAPLAN, *University of Michigan*

This text by the author of the distinguished *Advanced Calculus* offers an introduction to differential equations especially suited for those going on in the field of instrumentation and control. It gives special emphasis to gaining a deeper understanding of the subject, rather than to learning special devices. Consequently, the differential equations are related to their applications in physics and engineering, especially with regard to those aspects which are important for *servomechanisms, computers,* and *automatic controls.* *534 pp, 150 illus, 1958—$9.50*

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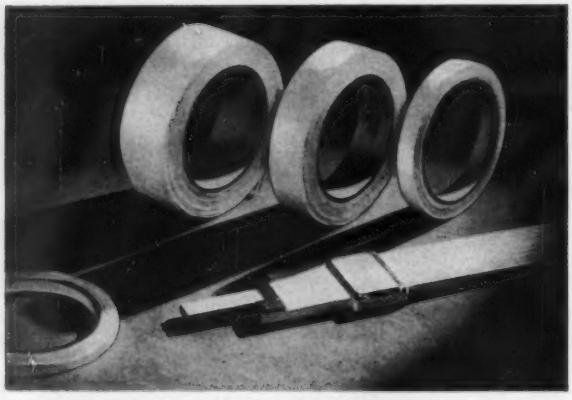

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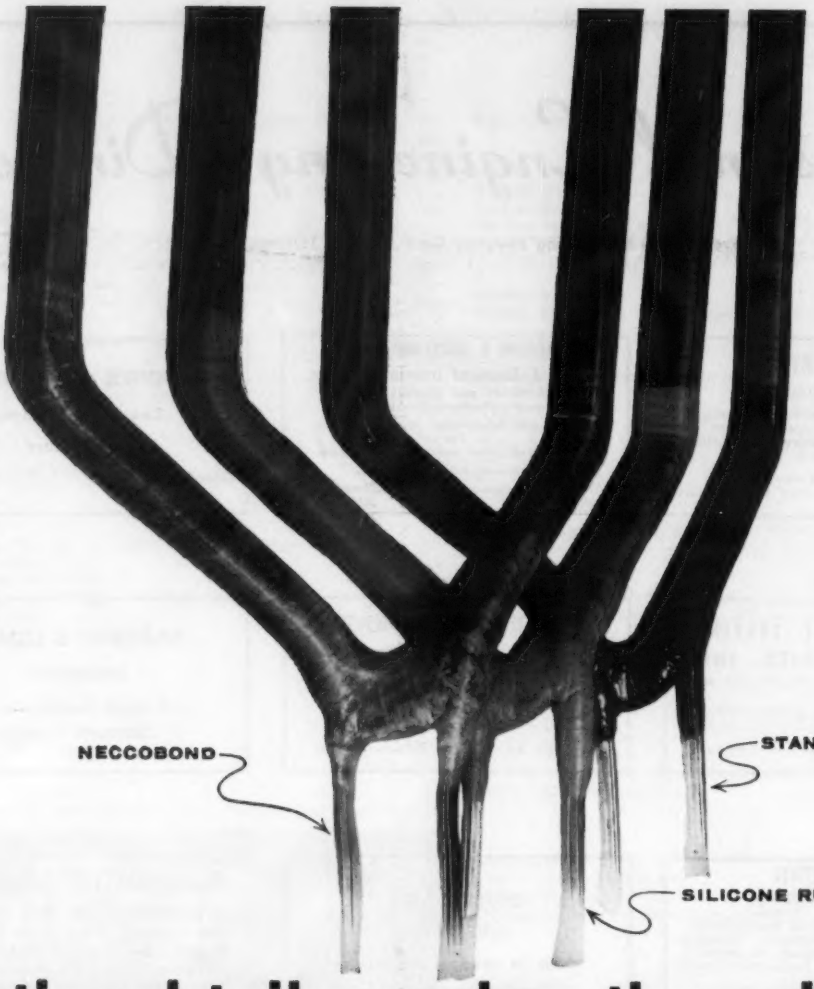

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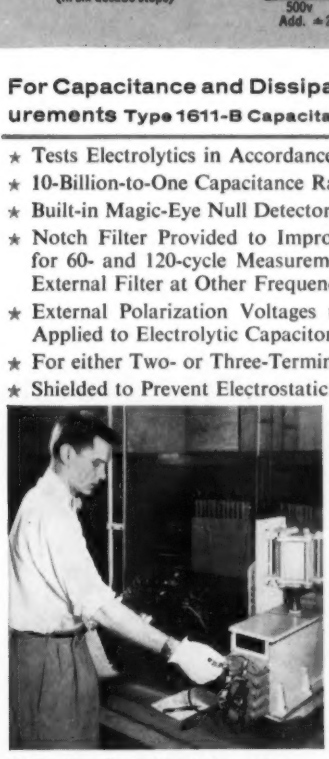

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